

MANUPP

MANUAL OF UPPER AIR OBSERVATIONS

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CHAPTER 1

HISTORY OF THE AEROLOGICAL NETWORK

1.1 NATIONAL UPPER AIR PROGRAM

During the 1930's, the development and testing of radiosonde instruments took place in many countries, including Canada. During the Second International Polar Year (1932-33), several "Moltchanoff" radiosondes were flown at Coppermine, N.W.T. These instruments radioed back temperature and pressure data. The highest ascent reached an altitude of 8,500 metres before succumbing to battery failure.

The Meteorological Service of Canada (MSC) developed a radiosonde which operated on a chronometric or time cycle principle. The first operational radiosonde station using the MSC radiosonde was located at Gander, Newfoundland in June, 1941. As near as can be determined, the first formal Upper Air Training Course in Canada was given in the fall of 1942. There were four students and the course was conducted by Mr. R.C. Jacobsen in the attic of the then headquarters of the MSC, at 315 Bloor Street West, in Toronto.

Through co-operation with the United States of America, a rapid expansion of the radiosonde network took place during World War II. By 1945 there were 25 radiosonde stations in Canada of which, 12 were operated by the United States Army Air Force. These stations used a United States Weather Bureau (USWB) radiosonde.

The MSC now operates 31 permanent aerological facilities, and 4 "on-demand" stations (see Fig. 1). The MSC also has the resources to deploy portable ground based stations during emergencies or special research projects. In addition to upper air observations, most aerological stations maintain a variety of supplementary programs.

By the early 1960's, use of the MSC radiosonde was replaced in favor of the USWB instrument. Prior to 1980, most data calculations were performed manually through the use of charts, tables and slide rule type calculators. The volume of computations (over 10 thousand) essential to complete an aerological observation required the services of two observers working together.

With the introduction of computers in the late 1970's, a station based mini-computer called ADRES (Aerological Data Reduction System) eliminated most of the routine manual computations required. It then became possible for one observer to complete a rawinsonde observation.

INTRODUCTION

PA-2

Computer systems of the 1980's evolved rapidly with respect to the use of microprocessor technology. This had a major impact on the development of upper air measurement techniques. By the late 1980's, Canada initiated a replacement of the ADRES computer with a more sophisticated sounding system called NAVOID (Navigational Aid). Using the NAVOID systems (Vaisala and VIZ), almost all of the routines for rawinsonde observations were automated. The VIZ equipment was phased out at the end of 1999.

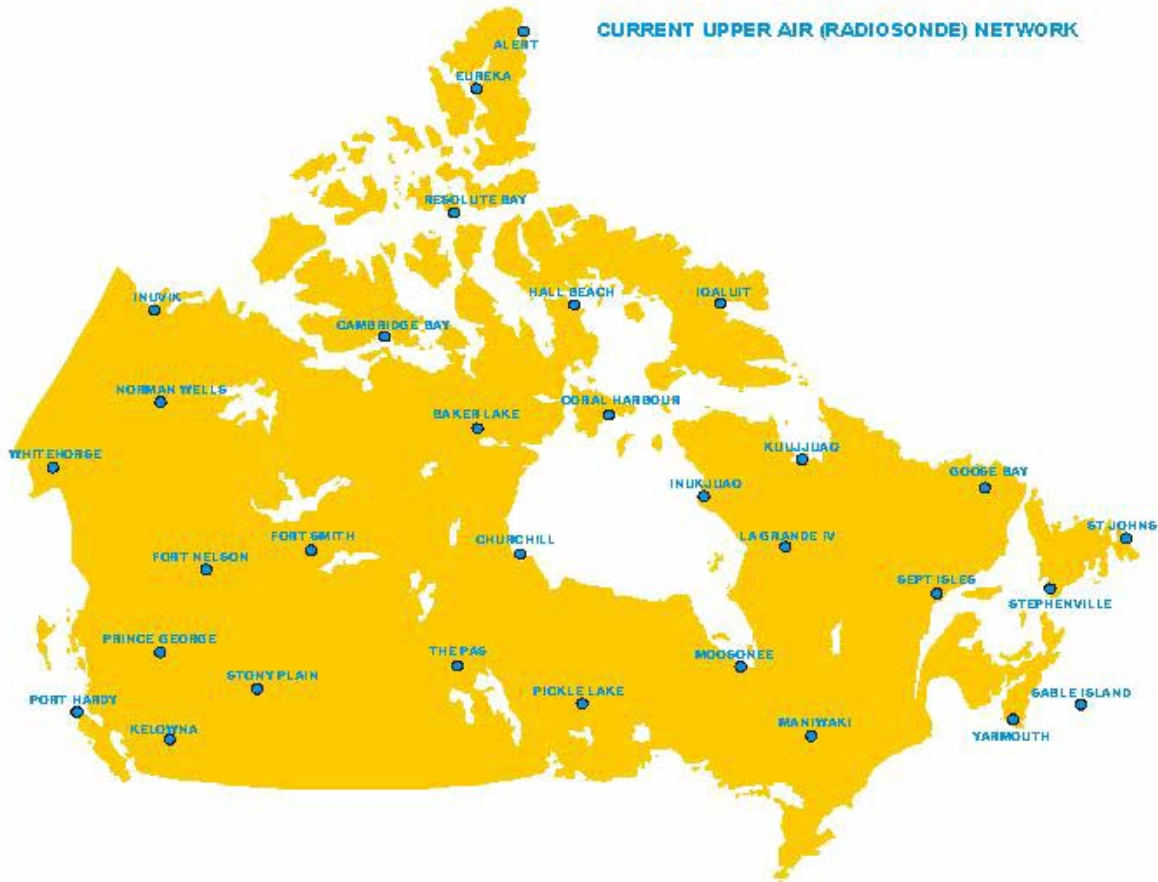


Figure 1 Canadian Upper Air Network

CHAPTER 1

STANDARDS

1.1 Performance Standards

1.1.1 Height

1. 60 % of flights must attain a pressure of 10 hPa or less;
2. 90 % of flights must attain a pressure of 30 hPa or less.

1.1.2 Ascent Rate

The standard ascent rate should be between 250 – 325 m/min

1.1.3 Second Release

A release is considered successful if acceptable pressure, temperature and relative humidity data are obtained up to and including the 400 hPa level.

Criteria

If a first attempt is unsuccessful a second attempt shall be made up until H + 1:45 or H + 13:45. Third releases are no longer attempted.

1.2 Ground Check Standards

1. Pressure + or – 5.0 hPa vs station barometer;
2. temperature + or – 2.0° C vs ground check box thermometer;
3. humidity + or – 5 % vs ground check box chamber.

1.3 Acclimatization Standard

If the difference between the operations room temperature and the outdoor temperature exceeds 20 °C the radiosonde must be acclimatized for a minimum of 10 minutes.

1.4 Standard Coding Levels

1.4.1 Pressure

| | | | |
|----------|---------|--------|-------|
| 1000 hPa | 300 hPa | 50 hPa | 3 hPa |
| 925 hPa | 250 hPa | 30 hPa | |
| 850 hPa | 200 hPa | 20 hPa | |
| 700 hPa | 150 hPa | 10 hPa | |
| 500 hPa | 100 hPa | 7 hPa | |
| 400 hPa | 70 hPa | 5 hPa | |

1.4.2 Wind

| | | | | |
|-----------|-------|---|-----------|---------|
| Surface | | | | |
| 1000 ft | 300 | m | 140000 ft | 47000 m |
| 2000 ft | 600 | m | | |
| 3000 ft | 900 | m | | |
| 4000 ft | 1200 | m | | |
| 6000 ft | 1800 | m | | |
| 7000 ft | 2100 | m | | |
| 8000 ft | 2400 | m | | |
| 9000 ft | 2700 | m | | |
| 12000 ft | 3600 | m | | |
| 14000 ft | 4200 | m | | |
| 16000 ft | 4800 | m | | |
| 20000 ft | 6000 | m | | |
| 25000 ft | 7500 | m | | |
| 30000 ft | 9000 | m | | |
| 35000 ft | 12000 | m | | |
| 50000 ft | 17000 | m | | |
| 70000 ft | 23000 | m | | |
| 90000 ft | 30000 | m | | |
| 100000 ft | 33000 | m | | |
| 110000 ft | 36000 | m | | |

1.4.3 Standard Significant Levels (Temperature)

1. Surface Level,
2. termination level,
3. departure from linearity of 1 °C or more between Surface – 100 hPa,
4. departure from linearity of 2 °C or more between 99 hPa and termination,
5. missing temperature data boundaries,
6. level within a missing temperature stratum,
7. minimum thickness of 20 hPa for an isothermal layer.

1.4.4 Standard Significant Levels (Relative Humidity)

1. Departure from linearity of 10 % between surface and termination,
2. relative humidity change of 20 % when determining isothermal inversion layer,
3. Tolerance of 4 % for relative humidity significant levels to coincide exactly with significant levels for temperature,
4. If the temperature is significant then a relative humidity level is chosen and the rest of the relative humidity significant levels are chosen using only the relative humidity profile.

1.4.5 Standard Significant Levels (Wind)

1. Surface level,
2. highest 300m/1000 ft level,
3. boundary levels of missing data stratum,
4. level within a missing data stratum,
5. levels adjacent to a calm stratum,
6. level of maximum wind,
7. tolerance of 10° for determining significant levels for wind direction,
8. lower limit for reporting maximum wind is 500 hPa,
9. if the wind speed is less than 5.0 m/sec significant levels are not chosen for direction,
10. lower and upper boundaries of calm stratum,
11. first edited data level having no interpolated wind data,
12. lower limit for speed of maximum wind is 30 m/sec,
13. tolerance of 5 m/sec for significant levels for wind speed.

Computation Standards (Wind)

There are 2 standards for wind computation :

Loran

| Buffer Control Parameter | Time |
|---------------------------------|-----------------------------------------------------------------|
| Start of Layer 1 | 0 s |
| Buffer Length 1 | 60 s (May be changed to 120 s where Loran coverage is marginal) |
| Start of Layer 2 | 600 s |
| Buffer Length 2 | 120 s |
| Start of Layer 3 | 2700 s |
| Buffer Length 3 | 240 s |
| Start of Layer 4 | 14400 s |
| Buffer Length 4 | 0 s |

VLF

| Buffer Control Parameter | Time |
|---------------------------------|-------------|
| Start of Layer 1 | 0 s |
| Buffer Length 1 | 250 s |
| Start of Layer 2 | 14400 s |
| Buffer Length 2 | 0 s |

1.4.6 Additional Standard Significant Levels

Levels identifying first and second tropopauses.

CHAPTER 2

THE UPPER AIR CODE

2.1 GENERAL

Upper air data is transmitted from Canadian aerological stations based on two general formats established by the World Meteorological Organization for Region IV :

1. Rawinsonde observations of altitude, pressure, temperature, dew point depression and wind speed and direction are coded using WMO code FM 35-X TEMP for land based stations and WMO code FM 36-X TEMP SHIP for sea based stations.
2. Upper wind observations are coded using WMO code FM 32-IX PILOT for land based stations, WMO code FM 33-IX PILOT SHIP for sea based stations and FM 34-IX PILOT MOBIL for mobile land stations.

2.2 MESSAGE SECTIONS

2.2.1 TEMP MESSAGES

The data contained in the messages are grouped into sections. The TEMP, TEMP SHIP and TEMP MOBIL messages may contain up to 10 sections depending on WMO Regional and National practices. These sections are :

1. Section 1 identification and position data (latitude, longitude, height, height confidence).
2. Section 2 data for surface and mandatory levels.
3. Section 3 data for tropopause levels.
4. Section 4 data for maximum wind levels.
5. Section 5 data for significant levels with respect to temperature and/or relative humidity.
6. Section 6 data for significant levels with respect to wind.
7. Section 7 data on sea surface temperature and sounding system.
8. Section 8 cloud data.
9. Section 9 regional code groups.
10. Section 10 national code groups.

Canadian aerological stations do not include all sections in their transmitted messages. TEMP, TEMP SHIP and TEMP MOBIL messages consist of Sections 1, 2, 3, 4, 5, 7, 9, and 10.

2.2.2 MESSAGE PARTS

Each of the coded messages is also divided into Parts A, B, C, and D. For Canadian TEMP, TEMP SHIP and TEMP MOBIL messages these parts contain :

PART A : The data up to and including the 100 hPa level for sections 1, 2, 3 and 4.

PART B : The data up to and including the 100 hPa for sections 1, 5, 7, 9, and 10.

PART C : The data above the 100 hPa level for sections 1, 2, 3, and 4.

PART D : The data above the 100 hPa level for sections 1, 5, 9 and 10.

The TEMP MOBIL message contains elevation data in section 1.

MESSAGE HEADERS

| | |
|--------------------|---------------------------------------------------------------------------------------|
| US Bulletin | TEMP data for mandatory pressure levels. |
| UK Bulletin | TEMP data for significant levels as determined by the ground equipment. |
| UG Bulletin | Contains PILOT data for fixed and significant wind levels. The format is not changed. |
| UL Bulletin | TEMP data for mandatory pressure levels. |
| UE Bulletin | TEMP data for significant levels as determined by the ground equipment. |
| UQ Bulletin | Contains PILOT data for fixed and significant wind levels. The format is not changed. |

2.2.3 TEMP OR TEMP SHIP MESSAGE PART A (US)**Section 1**

| | | | |
|----------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------|----------------------------------------------------|
| M _i M _i M _i M _j | YYGGI _d | IIiii | (Identification groups for land stations) |
| | or | | |
| M _i M _i M _i M _j | D...D YYGGI _d | 99L _a L _a L _a | (Identification position groups for ship stations) |
| Q _c L _o L _o L _o L _o | MMMU _{L_a} U _{L_o} | | |

Section 2

| | | | |
|------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------|--------------------|
| 99P _o P _o P _o | T _o T _o T _{ao} D _o D _o | d _o d _o f _o f _o | (Surface data) |
| 00hhh | TTT _a DD | ddfff | |
| 92hhh | TTT _a DD | ddfff | |
| 85hhh | TTT _a DD | ddfff | |
| 70hhh | TTT _a DD | ddfff | |
| 50hhh | TTT _a DD | ddfff | |
| 40hhh | TTT _a DD | ddfff | (Mandatory levels) |
| 30hhhT | TTT _a DD | ddfff | |
| 25hhh | TTT _a DD | ddfff | |
| 20hhh | TTT _a DD | ddfff | |
| 15hhh | TTT _a DD | ddfff | |
| 10hhh | TTT _a DD | ddfff | |

Section 3

| | | | |
|------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------|-------------------|
| 88P _t P _t P _t | T _t T _t T _{at} D _t D _t | d _t d _t f _t f _t | (Tropopause data) |
| or 88999 | | | |

Section 4

| | | | |
|----------------------------------------------------------------|--|--|---------------------|
| 77P _m P _m P _m | | | (Maximum wind data) |
| or d _m d _m f _m f _m | | | |
| 66P _m P _m P _m or 77999 | | | |

Figure PB-1 Symbolic code forms of PART A of the first transmission of a Rawinsonde message used by land and ship stations

2.2.4 TEMP OR TEMP SHIP MESSAGE PART B (UK)**Section 1**

| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------|
| M _i M _i M _j M _j | YYGG _{a4} | IIiii | (Identification groups for land stations) |
| or | | | |
| M _i M _i M _j M _j Q _c L _o L _o L _o L _o | D...D YYGG _{a4} MMM _{U_{La}} U _{Lo} | 99L _a L _a L _a | (Identification position groups for ship stations) |

Section 5

| | | |
|------------------------------------------------|-----------------------------------------------------------------------------|----------------------|
| 00P _o P _o P _o | T _o T _o T _{ao} D _o D _o | (Surface data) |
| 11PPP | TTT _a DD | and |
| 22PPP | TTT _a DD | (significant levels) |
| 33PPP | TTT _a DD | |
| etc. | | |

Section 7

| | | | |
|----------------------------------------------------------------------------------|-------|--------------------------------------------------------------|---------------------------------------------|
| 31313 s _r r _a r _a s _a s _a | 8GGgg | 9s _n T _w T _w T _w | (Sounding system data and sea surface data) |
|----------------------------------------------------------------------------------|-------|--------------------------------------------------------------|---------------------------------------------|

Section 9

| | |
|------------------------------------------|------------------------------------|
| 51515 101A _{df} A _{df} | (Regional codes - additional data) |
|------------------------------------------|------------------------------------|

Section 10

| | |
|------------------------------------------|------------------------------------|
| 61616 101A _{df} A _{df} | (National codes - additional data) |
|------------------------------------------|------------------------------------|

Figure PB-2 Symbolic code forms of PART B of the first transmission of a Rawisonde message used by land and ship stations

2.2.5 TEMP OR TEMP SHIP MESSAGE PART C (UL)**Section 1**

| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------|----------------------------------------------------|
| M _i M _i M _j M _j | YYGGI _d | IIiii | (Identification groups for land stations) |
| or | | | |
| M _i M _i M _j M _j Q _c L _o L _o L _o L _o | D...D YYGGI _d MMMU _{La} U _{Lo} | 99L _a L _a L _a | (Identification position groups for ship stations) |

Section 2

| | | |
|---------------------------|-------|--------------------|
| 70hhh TTT _a DD | ddfff | |
| 50hhh TTT _a DD | ddfff | |
| 30hhh TTT _a DD | ddfff | |
| 20hhh TTT _a DD | ddfff | |
| 10hhh TTT _a DD | ddfff | (Mandatory levels) |
| 07hhh TTT _a DD | ddfff | |
| 05hhh TTT _a DD | ddfff | |
| 03hhh TTT _a DD | ddfff | |
| 02hhh TTT _a DD | ddfff | |
| 01hhh TTT _a DD | ddfff | |

Section 3

| | | | |
|------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------|
| 88P _t P _t P _t | T _t T _t T _{at} D _t D _t | d _t d _t f _t f _t f _t | (Tropopause data) |
| or | | | |
| 88999 | | | |

Section 4

| | | | |
|------------------------------------------------|----------------------------------------------------------------------------|--|---------------------|
| 77P _m P _m P _m | | | |
| or | d _m d _m f _m f _m f _m | | (Maximum wind data) |
| 66P _m P _m P _m | | | |
| or | | | |
| 77999 | | | |

Figure PB-3 Symbolic code forms of PART C of the second transmission of a Rawinsonde message used by land and ship stations

2.2.6 TEMP OR TEMP SHIP MESSAGES PART D (UE)**Section 1**

| | | | |
|-----------------------|------------------------------------|------------------------------------------------|----------------------------------------------------|
| $M_i M_i M_j M_j$ | YYGG/ | lliii | (Identification groups for land stations) |
| or | | | |
| $M_i M_i M_j M_j$ | D...D YYGG _{a4} | 99L _a L _a L _a | (Identification position groups for ship stations) |
| $Q_c L_o L_o L_o L_o$ | MMMU _{La} U _{Lo} | | |

Section 5

| | | |
|-------|---------------------|----------------------|
| 11PPP | TTT _a DD | |
| 22PPP | TTT _a DD | |
| 33PPP | TTT _a DD | (Significant levels) |
| 44PPP | TTT _a DD | |
| etc. | | |

Section 9

| | |
|------------------------------------------|-----------------------------------|
| 51515 101A _{df} A _{df} | (Regional codes- additional data) |
|------------------------------------------|-----------------------------------|

Section 10

| | |
|------------------------------------------|------------------------------------|
| 61616 101A _{df} A _{df} | (National codes - additional data) |
|------------------------------------------|------------------------------------|

Figure PB-4 Symbolic code forms of PART D of the second transmission of a Rawinsonde message used by land and ship stations

2.3 TEMP MESSAGE CONTENT**2.3.1 SECTION 1**

The purpose of section 1 is to identify the type, origin and time of the message, and is included in each part.

2.3.1.1 MESSAGE INDICATOR $M_i M_i M_j M_j$

This four letter group contains identification data and is the first group in the coded message :

$M_i M_i$: The symbolic code for identifying a rawinsonde or radiosonde message originating from a land or ship station. A TEMP message is coded as TT, a TEMP SHIP is coded as UU and a TEMP MOBIL is coded as ll;

$M_j M_j$: The symbolic code for identifying the PART of the message that is to follow (i.e. PARTS A, B, C or D) PART A is coded as AA, PART B as BB, etc.

2.3.1.2 DATE INDICATOR YYGGI_D (Parts A,C,D) AND YYGG_{a4} (Part B)

YY : Identifies the day of the month and the unit of wind speed (i.e. knots or meters per second) that is used in the message.

1. The day of the month is reported through the use of code figures 01 to 31, inclusive, where code figure 01 means the 1st day of the month, 02 means 2nd day of the month, etc.
2. The unit of wind speed is reported as follows :
 - A. When wind speeds are reported in knots, 50 is added to YY (Canadian upper air messages always use knots);
 - B. when wind speeds are reported in meters per second, YY is not modified.

GG : Identifies the time of observation in whole hours, Co-ordinated Universal Time (UTC), based on the twenty-four hour clock (i.e. 00 to 23).

1. The standard hour of observation, H, is coded for **GG** whenever the release time is within the time range of H-4 5 to H+29 inclusive. (e.g. if the release time is 2315, **GG** is coded as 00);
2. if the release time is outside of the range of H-45 to H+29 **GG** is coded to the nearest hour UTC (e.g. if the release time is 0030, **GG** is coded as 01).

I_a : Identifies the last mandatory level for which wind data is reported. (For Parts A, C, and D, Refer to Table 2-1 WMO 1734. For Part B only, refer to Table 2-9 WMO 3333)

WMO CODE 1734

| Code Figures for I _d | Pressure of Mandatory Level | |
|---------------------------------|------------------------------------------------|------------------------------------------------|
| | Part A | Part B |
| 1 | 100 or 150 hPa | 10 hPa |
| 2 | 200 or 250 hPa | 20 hPa |
| 3 | 300 hPa | 30 hPa |
| 4 | 400 hPa | |
| 5 | 500 hPa | 50 hPa |
| 6 | | |
| 7 | 700 hPa | 70 hPa |
| 8 | 850 hPa | |
| 9 | 925 hPa | |
| 0 | 1000 hPa | |
| / | No wind group included for any mandatory level | No wind group included for any mandatory level |

Table 2-1 Selection of code figure I_a

2.3.1.3 INTERNATIONAL INDEX NUMBER Iiii

This five figure group constitutes the International Index Number :

I : Identifies the block number which defines the area in which the reporting station is situated. Each block contains 1000 station numbers and is allocated to one or more countries within a WMO region. All stations within Canada use the block number 71;

iii : Refers to the three digit number allocated to Meteorological Services in one or more countries within a WMO region.

2.3.2 SECTION 2 : MANDATORY LEVELS

The purpose of section 2 is to report temperature, dew point depression, altitude and wind data corresponding to the mandatory pressure levels. The data for a mandatory level is normally coded into three consecutive groups. The first group contains the level identifier and the altitude expressed in geopotential meters; the second group contains temperature and dew point depression data while the third group is the coded wind direction and speed.

2.3.2.1 MANDATORY LEVELS (PRESSURE) 99P_oP_oP_o

99 : The digits 99 indicate that surface level data is to follow;

P_oP_oP_o : The hundreds, tens and units digits corresponding to the surface pressure expressed in hPa.

2.3.2.2 MANDATORY LEVELS (HEIGHTS) XXhhh

XX : Level identifier (refer to Table 2-2);

hhh :

- (1) Indicates in whole geopotential metres the altitudes of the 1000, 925, 850 and 700 hPa levels;
- (2) indicates the thousands, hundreds and tens digits of the altitude in geopotential metres for the 500 hPa level and higher. For example, 5560 gpm is coded as 556; 16280 gpm is coded as 628;
- (3) when the altitude of the 1000 hPa level is computed to be below sea level (i.e. a negative number), 500 is added to its value.

| PART A | PART C | LEVEL |
|--------|--------|----------|
| 00 | | 1000 hPa |
| 92 | | 925 hPa |
| 85 | | 850 hPa |
| 70 | | 700 hPa |
| 50 | | 500 hPa |
| 30 | | 300 hPa |
| 25 | | 250 hPa |
| 20 | | 200 hPa |
| 15 | | 150 hPa |
| 10 | | 100 hPa |
| | 70 | 70 hPa |
| | 50 | 50 hPa |
| | 30 | 30 hPa |
| | 20 | 20 hPa |
| | 10 | 10 hPa |
| | 07 | 7 hPa |
| | 05 | 5 hPa |

Table 2-2 Pressure corresponding to level identifiers XX

2.3.2.3 MANDATORY LEVELS (TEMPERATURES) $T_oT_oT_{ao}D_oD_o$ and TTT_aDD

These groups contain temperature and dew point depression data corresponding to the mandatory level, XX, in the immediately preceding group. The subscript "o" in the symbolic code indicates surface level data.

T_oT_o and TT : Represent the tens and unit's value of the temperature;

T_{ao} and T_a : Represent the approximate tenths value and the sign (i.e. positive or negative) of the values for TT and T_oT_o . When this digit is an odd number, the temperature is negative and when this digit is an even number, the temperature is positive. (Refer to Table 2-3)

D_oD_o and DD : Represent the dew point depression with respect to water, (i.e. the difference between the air temperature and the dew point temperature expressed in degrees Celsius. (Refer to Table 2-4 WMO 0777)

| Tenths Figure Observed Air Temperature | Code Figure for T_a T_{ao} T_{at} | |
|----------------------------------------------|-----------------------------------------|-------------------------|
| | Positive Temperature | Negative Temperature |
| 0 | 0 | |
| 1 | | 1 |
| 2 | 2 | |
| 3 | | 3 |
| 4 | 4 | |
| 5 | | 5 |
| 6 | 6 | |
| 7 | | 7 |
| 8 | 8 | |
| 9 | | 9 |

Table 2-3 Determining code figure for T_a T_{ao} T_{at}

WMO Code 0777

| Dew Point Depression C° | Code Figure | Dew Point Depression C° | Code Figure | Dew Point Depression C° | Code Figure |
|-------------------------|-------------|-------------------------|-------------|-------------------------|-------------|
| 0.0 | 00 | 3.4 | 34 | 18 | 68 |
| 0.1 | 01 | 3.5 | 35 | 19 | 69 |
| 0.2 | 02 | 3.6 | 36 | 20 | 70 |
| 0.3 | 03 | 3.7 | 37 | 21 | 71 |
| 0.4 | 04 | 3.8 | 38 | 22 | 72 |
| 0.5 | 05 | 3.9 | 39 | 23 | 73 |
| 0.6 | 06 | 4.0 | 40 | 24 | 74 |
| 0.7 | 07 | 4.1 | 41 | 25 | 75 |
| 0.8 | 08 | 4.2 | 42 | 26 | 76 |
| 0.9 | 09 | 4.3 | 43 | 27 | 77 |
| 1.0 | 10 | 4.4 | 44 | 28 | 78 |
| 1.1 | 11 | 4.5 | 45 | 29 | 79 |
| 1.2 | 12 | 4.6 | 46 | 30 | 80 |
| 1.3 | 13 | 4.7 | 47 | 31 | 81 |
| 1.4 | 14 | 4.8 | 48 | 32 | 82 |
| 1.5 | 15 | 4.9 | 49 | 33 | 83 |
| 1.6 | 16 | 5 | 50 | 34 | 84 |
| 1.7 | 17 | Not Used | 51 | 35 | 85 |
| 1.8 | 18 | Not Used | 52 | 36 | 86 |
| 1.9 | 19 | Not Used | 53 | 37 | 87 |
| 2.0 | 20 | Not Used | 54 | 38 | 88 |
| 2.1 | 21 | Not Used | 55 | 39 | 89 |
| 2.2 | 22 | 6 | 56 | 40 | 90 |
| 2.3 | 23 | 7 | 57 | 41 | 91 |
| 2.4 | 24 | 8 | 58 | 42 | 92 |
| 2.5 | 25 | 9 | 59 | 43 | 93 |
| 2.6 | 26 | 10 | 60 | 44 | 94 |
| 2.7 | 27 | 11 | 61 | 45 | 95 |
| 2.8 | 28 | 12 | 62 | 46 | 96 |
| 2.9 | 29 | 13 | 63 | 47 | 97 |
| 3.0 | 30 | 14 | 64 | 48 | 98 |
| 3.1 | 31 | 15 | 65 | 49 | 99 |
| 3.2 | 32 | 16 | 66 | | |
| 3.3 | 33 | 17 | 67 | | |

Table 2-4 Determining code figures for the dew point depression

2.3.2.4 MANDATORY LEVELS (WIND) d_od_of_of_o and ddfff

This group contains wind direction and speed data for the mandatory level XX. The subscript "o", in the symbolic form, indicates surface data.

dd : The hundreds and tens digits of the wind direction;

fff : The first digit represents the units value of the wind direction rounded to the nearest 5 degrees. The final two digits represent the tens and units value of the wind speed. If, however, the wind speed is 100 knots or greater, the hundreds digit of the wind speed is added to the value of the first digit.

Examples :

| | | |
|-----|----------------|-----------|
| (1) | Wind direction | 291 |
| | Wind speed | 55 knots |
| | Coded value | 29055 |
| (2) | Wind direction | 293 |
| | Wind speed | 55 knots |
| | Coded value | 29555 |
| (3) | Wind direction | 289 |
| | Wind speed | 106 knots |
| | Coded value | 29106 |
| (4) | Wind direction | 304 |
| | Wind speed | 201 knots |
| | Coded value | 30701 |

2.3.3 SECTION 3 : TROPOPAUSE DATA, PARTS A and C

This section reports tropopause data in PARTS A and C of the message.

2.3.3.1 TROPOPAUSE (PRESSURE) 88P_tP_tP_t

88 : The digits 88 indicate that tropopause data are to follow;

P_tP_tP_t : The hundreds, tens and units digits corresponding to the pressure at the tropopause level;

88999 : Indicates the message does not contain tropopause data.

2.3.3.2 TROPOPAUSE (TEMPERATURE) T_tT_tT_{at}D_tD_t

Tropopause temperature and dew point depression data are coded in the same manner as TTT_aDD (refer to section 2.3.2.3).

2.3.3.3 TROPOPAUSE (WIND) d_td_tf_tf_t

Tropopause wind direction and speed. These are coded in the same manner as ddff (refer to section 2.3.2.4).

2.3.4 SECTION 4: MAXIMUM WIND, PARTS A and C

This section reports maximum wind data in PARTS A and C of the message. A level of maximum wind is defined as a level at which the wind speed is greater than at levels adjacent to it (i.e. immediately above and below it). If the highest wind speed occurs in a layer of equal winds, then the level at the top of this layer is considered the maximum wind.

2.3.4.1 MAXIMUM WIND (UPPER LEVEL) 77P_mP_mP_m

77 : Indicates that maximum wind data, meeting these criteria, are to follow :

- (1) Wind data are available both above and below the level of maximum wind;
- (2) the wind speed is greater than 60 knots;
- (3) for PART A of the message, it is the highest wind speed occurring above 500 hPa and up to and including 100 hPa;
- (4) for PART C of the message, it is the highest wind speed above 100 hPa.

P_mP_mP_m : Indicates the pressure at the level of the maximum wind :

- (1) In **PART A** of the message, this represents the hundreds, tens and units digits corresponding to the pressure at the level of the maximum wind;
- (2) in **PART C** of the message, this represents the tens, units and tenths digits corresponding to the pressure at the level of the maximum wind.

77999 : Indicates the message does not contain maximum wind data.

2.3.4.2 MAXIMUM WIND (SOUNDING) 66P_mP_mP_m

66 : The digits 66 indicate that maximum wind data , meeting these criteria ,are to follow :

- (1) It is at the terminating level of the wind sounding;
- (2) the wind speed is greater than 60 knots;
- (3) it is the highest wind speed in the sounding;
- (4) it occurs above the 500 hPa level.

P_mP_mP_m : Indicates the pressure at the level of the maximum wind :

- (1) In **PART A** of the message, this represents the hundreds, tens and units digits corresponding to the pressure at the level of the maximum wind;
- (2) in **PART C** of the message, this represents the tens, units and tenths digits corresponding to the pressure at the level of the maximum wind.

2.3.4.3 WIND DIRECTION d_md_mf_mf_mf_m

d_md_m : The hundreds and tens digits of the wind direction;

f_mf_mf_m : The first digit represents the units value of the wind direction rounded to the nearest 5 degrees. The final two digits represent the tens and units value of the wind speed. If, however, the wind speed is 100 knots or greater, the hundreds digit of the wind speed is added to the value of the first digit.

2.3.5 SECTION 5: SIGNIFICANT LEVELS

The purpose of section 5 is to report significant levels selected for coding on the basis of temperature and humidity.

2.3.5.1 SURFACE LEVEL 00P_oP_oP_o

00 : The digits 00 indicate that surface level data is to follow;

P_oP_oP_o : Indicates the hundreds, tens and units values corresponding to the surface pressure.

2.3.5.2 SIGNIFICANT LEVELS (PRESSURE) XXPPP

XX : These are the indicator figures used to identify the significant levels selected for coding. The significant levels are numbered in consecutive order with respect to height (i.e. 11, 22, 33, 44, etc.). After 99, the numbers restart at 11 (i.e. 99, 11, 22, etc.);

PPP : Indicates the pressure of the significant levels :

- (1) All pressures up to and including the 100 hPa level are reported to the nearest whole hPa using the hundreds, tens and units digits (e.g. 1023.4 hPa would be coded 023, 991.7 as 992);
- (2) all pressures above the 100 hPa level are reported to 0.1 hPa using the tens, units and tenths digits (e.g. 76.0 hPa would be coded 760, 9.6 as 096).

2.3.5.3 SIGNIFICANT LEVELS (TEMPERATURES) TTT_aDD and T_oT_oT_{ao}D_oD_o

These groups are coded in the same manner as their corresponding groups in section 2 (refer to par. 2.3.2.3).

2.3.6 SECTION 7 : SOUNDING SYSTEM AND SEA SURFACE DATA

The purpose of this section is to report additional data about the sounding, i.e. type of radiosonde, type of tracking system, time of launch, (release) and sea surface data, (if applicable.)

31313 : This is the indicator for section 7;

s_r : This is the indicator for the solar radiation correction that is applied to the sounding (refer to Table 2-5);

r_ar_a : Radiosonde sounding system used (refer to Table 2-6 WMO 3685);

s_as_a : Tracking technique/status of system used (refer to Table 2-7);

8GGgg : Actual time of launch (release) of the radiosonde (hours and minutes UTC);

9S_nT_wT_wT_w : Report of sea surface temperature in tenths of degrees C, its sign being given by S_n (optional group).

WMO

| Code | Specification |
|------|-----------------------------------------------------------------|
| 0 | No Correction |
| 1 | CIMO solar corrected and CIMO infrared corrected |
| 2 | CIMO solar corrected and infrared corrected |
| 3 | CIMO solar corrected only |
| 4 | Solar and infrared corrected automatically by radiosonde system |
| 5 | Solar corrected automatically by radiosonde system |
| 6 | Solar and infrared corrected as specified by country |
| 7 | Solar corrected as specified by country |

Table 2-5 Solar and infrared radiation correction S_r

WMO Code Table 3685

| Code | Specification |
|-------------|------------------------------------------------------------------|
| 02 | No radiosonde/passive target (e.g. balloon plus reflector, etc.) |
| 03 | No radiosonde/active target (e.g. balloon plus transponder) |
| 04 | No radiosonde/passive temperature – humidity profiler |
| 05 | No radiosonde/active temperature – humidity profiler |
| 06 | No radiosonde/radio – acoustic sounder |
| 07 | No radiosonde/reserved |
| 08 | No radiosonde/reserved |
| 09 | No radiosonde/sounding system not specified or unknown |
| 10 | RS VIZ type A pressure commutated (USA) |
| 11 | RS VIZ type B time commutated (USA) |
| 12 | RS SDC (space data corporation – USA) |
| 13 | Astor (no longer made – Australia) |
| 14 | VIZ Mark 1 microsonde (USA) |
| 15 | EEC company type 23 (USA) |
| 16 | Elin (Austria) |
| 17 | Graw G. (Germany) |
| 18 | Reserved for allocation of radiosondes |
| 19 | Graw M60 (Germany) |
| 20 | Indian Meteorological Service MK3 (India) |
| 21 | VIZ/Jin Yang Mark 1 Microsonde (South Korea) |
| 22 | Meisei RS2-80 (Japan) |
| 23 | Mesural FM0 1950A (France) |
| 24 | Mesural FM0 1945A (France) |
| 25 | Mesural MH73A (France) |
| 26 | Meteolabor Basora (Switzerland) |
| 27 | AVK – MRZ (Russian Federation) |
| 28 | Meteorit Marz 2-1 (Russian Federation) |
| 29 | Meteorit Marz 2-2 (Russian Federation) |
| 30 | Oki RS 2-80 (Japan) |
| 31 | VIZ/Valcom type A pressure commutated (Canada) |
| 32 | Shanghai Radio (China) |
| 33 | UK Meteorological Office MK3 (UK) |
| 34 | Vinohrady (Czechoslovakia) |
| 35 | Vaisala RS18 (Finland) |
| 36 | Vaisala RS21 (Finland) |
| 37 | Vaisala RS80 (Finland) |
| 38 | VIZ LOCATE Loran – C (USA) |
| 39 | Sprenger E076 (Germany) |
| 40 | Sprenger E084 (Germany) |
| 41 | Sprenger E085 (Germany) |
| 42 | Sprenger E086 (Germany) |
| 43 | AIR - IS - 4A - 1680 (USA) |

| | |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 44 | AIR - IS - 4A - 1680 (USA) |
| 45 | RS MSS (USA) |
| 46 | AIR - IS - 4A - 403 (USA) |
| 47 | Meisei RS2-91 (Japan) |
| 48 | VALCOM (Canada) |
| 49 | VIZ MARK II (USA) |
| 50 | GRAW DFM-90 (Germany) |
| 51 | VIZ-B2 (USA) |
| 52 | Vaisala RS80 – 57H |
| 53 | AVK – RF95 (Russian Federation) |
| 54 | GRAW DFM-97 (Germany) |
| 55-59 | Reserved for allocation of radiosondes |
| 60 | Vaisala RS80/MicroCora (Finland) |
| 61 | Vaisala RS80/Loran/Digicora I, II or Marvin (Finland) |
| 62 | Vaisala RS80/PCCora (Finland) |
| 63 | Vaisala RS80/Star (Finland) |
| 64 | Orbital Sciences Corporation, Space Data Division Transponder Radiosonde, Type 909-11-XX, where XX corresponds to the model of the instrument (USA) |
| 65 | VIZ Transponder Radiosonde, model # 1499-520 (USA) |
| 66 | Vaisala RS80/Autosonde (Finland) |
| 67 | Vaisala RS80/Digicora III (Finland) |
| 68-70 | Reserved for Additional Automated Sounding Systems |
| 71 | Vaisala RS90/Loran/Digicora I, II or Marvin (Finland) |
| 72 | Vaisala RS90/PC-Cora (Finland) |
| 73 | Vaisala RS90/Autosonde (Finland) |
| 74 | Vaisala RS90/Dstar (Finland) |
| 75 | AVK-MRZ-ARMA (Russian Federation) |
| 76 | AVK-RF95-ARMA (Russian Federation) |
| 77 | GEOLINK GPSonde GL98 (France) |
| 78 | Vaisala RS90/Digicora III (Finland) |
| 79-81 | Reserved for additional automated sounding systems |
| 82 | Sippican MK2 GPS/Star (USA) |
| 83 | Sioppican MK2 GPS/W9000 (USA) |
| 84-89 | Reserved for additional automated sounding systems |
| 90 | Radiosonde not specified or unknown |
| 91 | Pressure only radiosonde |
| 92 | Pressure only radiosonde plus transponder |
| 93 | Pressure only radiosonde plus radar reflector |
| 94 | No pressure radiosonde plus transponder |
| 95 | No pressure radiosonde plus radar reflector |
| 96 | Descending radiosonde |
| 97-99 | Reserved for allocation of sounding systems with incomplete sondes |

Table 2-6 Type of Radiosonde/sounding system in use r_ar_a

| Code | Specification |
|-------------|------------------------------------------------------|
| 00 | No wind finding |
| 01 | Automatic with auxiliary optical direction finding |
| 02 | Automatic with auxiliary radio direction finding |
| 03 | Automatic with auxiliary ranging |
| 04 | Not used |
| 05 | Automatic with multiple VLF – Omega frequencies |
| 06 | Automatic cross chain Loran – C |
| 07 | Automatic with auxiliary wind profiler |
| 08 | Automatic satellite navigation |
| 09-18 | Reserved |
| 19 | Tracking technique not specified |
| 20-29 | Ship systems – reserved for ASAP |
| 30-39 | Sounding systems – reserved for ASAP |
| 40-49 | Launch facilities – reserved for ASAP |
| 50-59 | Data acquisition systems – reserved for ASAP |
| 60-69 | Communications – reserved for ASAP |
| 70 | All systems in normal operations – reserved for ASAP |

Table 2-7 Tracking system/status of system used s_as_a

2.3.7 SECTION 9 : REGIONAL CODE GROUPS

The purpose of this section is to report regionally developed code groups.

51515 : This is the indicator group for section 9;

101A_{df}A_{df} : **101** : The three digit indicator 101 identifies the additional data group;

A_{df}A_{df} : This two digit group identifies the additional data as specified in Table 2-8.

WMO Code Table 421

| Code | Specification |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 40-59 | Reason for no report or incomplete report |
| 40 | Report not Filed |
| 41 | |
| 42 | Ground equipment failure |
| 43 | Observation delayed |
| 44 | Power failure |
| 45 | Unfavourable weather conditions |
| 46 | Low maximum altitude (less than 500 metres above ground) |
| 47 | Leaking balloon |
| 48 | Ascent not authorized for this period |
| 49 | Alert |
| 50 | Ascent did not ascend above 400 hPa |
| 51 | Balloon forced down by icing conditions |
| 52 | Balloon forced down by precipitation |
| 53 | Atmospheric interference |
| 54 | Local interference |
| 55 | Fading signal |
| 56 | Weak signal |
| 57 | Preventive maintenance |
| 58 | Flight equipment failure |
| 59 | Any reason not listed above |
| 60-64 | Miscellaneous |
| 60 | |
| 61 | |
| 62 | Radiosonde report precedes |
| 63 | |
| 64 | |
| 65-69 | Doubtful data |
| 65 | Geopotential and temperature data are doubtful between the following levels 0PnPnPnPn |
| 66 | Geopotential data doubtful between the following levels 0PnPnPnPn |
| 67 | Temperature data doubtful between the following levels 0PnPnPnPn |
| 68 | Dew point depression is missing for reasons other than motor boating between the following levels 0PnPnPnPn (not used when TnTn is also missing) |
| 69 | |
| 70-74 | Not allocated |
| 70 | |
| 71 | |
| 72 | |
| 73 | |
| 74 | |
| 75-89 | Corrected Data |

| | |
|----|-------------------------------------------------------------------------------------------|
| 75 | |
| 76 | |
| 77 | |
| 78 | Corrected tropopause data section follows |
| 79 | Corrected maximum wind section follows |
| 80 | Corrected report for the entire report (first plus second transmission) precedes |
| 81 | Corrected report for the entire first transmission precedes |
| 82 | Corrected report for entire second transmission precedes |
| 83 | Corrected data for mandatory levels follows |
| 84 | Corrected data for significant levels follows |
| 85 | Minor errors in this report : Correction follows |
| 86 | Significant levels not included in original report follow |
| 87 | Corrected data for surface follow |
| 88 | Corrected additional data groups follow |
| 90 | Extrapolated geopotential data follows |
| 91 | Extrapolated surface data precede (used only in dropsonde) |
| 92 | Termination altitude data follows |
| 93 | |
| 94 | Averaged wind for the surface to 1500 meter layer and the 1500 – 3000 metre layer follows |
| 95 | Early transmission of 850 and 500 hPa data and stability index follows |
| 96 | Early transmission of 850, 700 and 500 hPa data and stability index follows |
| 97 | Early transmission of 500 hPa data and stability index follow |
| 98 | Early transmission of 700 hPa data and stability index follow |
| 99 | Not to be allocated |

Table 2-8 Additional data code figures 40-99 A_{df}A_{df}

2.3.8 SECTION 10 : NATIONAL CODE GROUPS

The purpose of this section is to report nationally developed code groups.

61616 : Indicates data in national code follows.

101A_{df}A_{df} : This is coded in the same manner as in section 9. (Refer to 2.3.7).

2.4 TEMP SHIP MESSAGE

The TEMP SHIP message is coded the same as a TEMP message with the exception of section 1. Therefore, only the differences in the coding of section 1 will be explained.

2.4.1 SECTION 1

2.4.1.1 LOCATION - LATITUDE 99L_aL_aL_a

99 : This is the group identifier;

L_aL_aL_a : These three digits represent the latitude of the point of observation. The latitude is reported in tens, units and tenths of degrees (e.g. 74.15 N is coded as 741).

2.4.1.2 LOCATION - LONGITUDE Q_cL_oL_oL_oL_o

Q_c : Represents the quadrant of the globe where the point of observation is located (refer to Table 2-8). If the ship is located on the equator or a prime meridian, two possible values occur, either one of which is acceptable;

L_oL_oL_oL_o : These digits represent the longitude of the point of observation. The longitude is reported in hundreds, tens, units and tenths of degrees.(e.g. 103.65 is coded as 1036).

WMO Table 3333

| LATITUDE | LONGITUDE | Q _c |
|----------|-----------|----------------|
| North | East | 1 |
| South | East | 3 |
| South | West | 5 |
| North | West | 7 |

Table 2-9 Values of Q_c in each quadrant of the earth

NOTE

The choice is left to the observer in the following cases :

- When the ship is on the Greenwich meridian or 180th Meridian (L_oL_oL_oL_o = 0000 or 1800 respectively),
 - Q_c = 1 or 7 (Northern hemisphere) or
 - Q_c = 3 or 5 (Southern hemisphere).
- When the ship is on the equator (L_aL_aL_a = 000),
 - Q_c = 1 or 7 (Eastern longitude) or
 - Q_c = 3 or 5 Western longitude).

2.4.1.3 LOCATION - SHIP $MMM U_{La} U_{Lo}$

This is the ship position verification group and is used to check the position of the ship in ship station messages.

MMM : This represents the Marsden square number in which the ship is located at the time of observation. The Marsden square number is determined from Figure PB-5 by using the latitude and longitude corresponding to the ship's position (e.g. If the ship's position is 46.0 N and 146.1 W, the Marsden square number is 159);

U_{La} : This is the units digit from the latitude corresponding to ship's position. (e.g. if the latitude is 45.9 N, U_{La} is coded as 5);

U_{Lo} : This is the units digit from the longitude corresponding to the ship's position (e.g. if the longitude is 145 W, U_{Lo} is coded as 5).

2.4.2 MARDEN SQUARES

When the latitude and longitude of the ship's position places the ship at the common intersection point of four Marsden squares, or the common side of two adjacent squares orientated East-West or North-South, the Marsden square number to be coded is determined by using the appropriate grid of the four grids shown in Figure PB-6. Each grid shows the 10 degree Marsden square divided into one-degree sub squares with a number assigned to each sub square (only a pattern of numbers is shown). The grid labeled A is used for Marsden squares in the North latitudes and West longitudes, i.e., $Q_c = 7$, and the grid labeled B is used for Marsden squares in the North latitudes and East longitudes, i.e. $Q_c = 1$, etc. It will be noted that the number of any sub square corresponds to the $U_{La} U_{Lo}$ for a ship positioned in the sub square. When the latitude and longitude values of the ship's position place the ship on the common side of two adjacent squares orientated North-South, the Marsden square number shall be determined as illustrated by the following example :

Assume the ship's position to be 50.0 N and 145. W. This position is on the boundary line of Marsden squares 195 and 159. (Figure PB-5).

Determine the $U_{La} U_{Lo}$ value from the ship's position. In the example $U_{La} U_{Lo}$ is 05; superimpose the appropriate grid, which in this example is grid A (see Fig. PB-6), on the adjacent Marsden squares 195 and 159, and select the Marsden square which when so subdivided displays the sub square numbered 05 adjacent to the ship's position. In the example the Marsden square is 195; code 195 for MMM.

The procedure for determining the Marsden square number, of a ship's position that places it on the common side of two squares which have oriented East-West, is the same as that used for the squares orientated North-South. When the latitude and longitude values of the ship's position place the ship at a common intersection of four squares, the appropriate grid must be applied to the four adjacent Marsden squares to determine the correct Marsden number. If the ship's position is on the equator, or on the 0 degree or 180 degree meridian, the number selected for Q_c shall determine the relevant Marsden square.

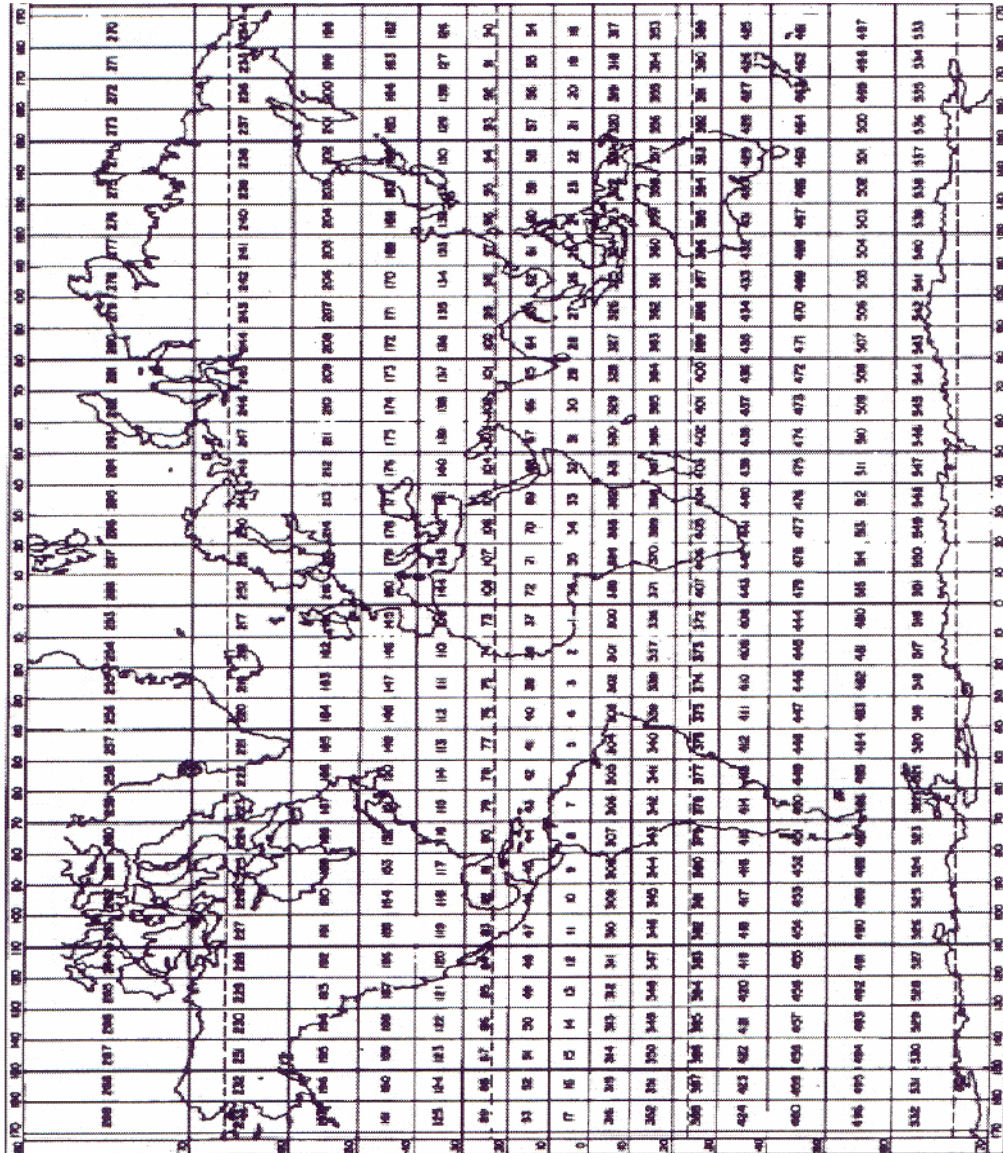


Figure PB-5 Marsden ten degree squares

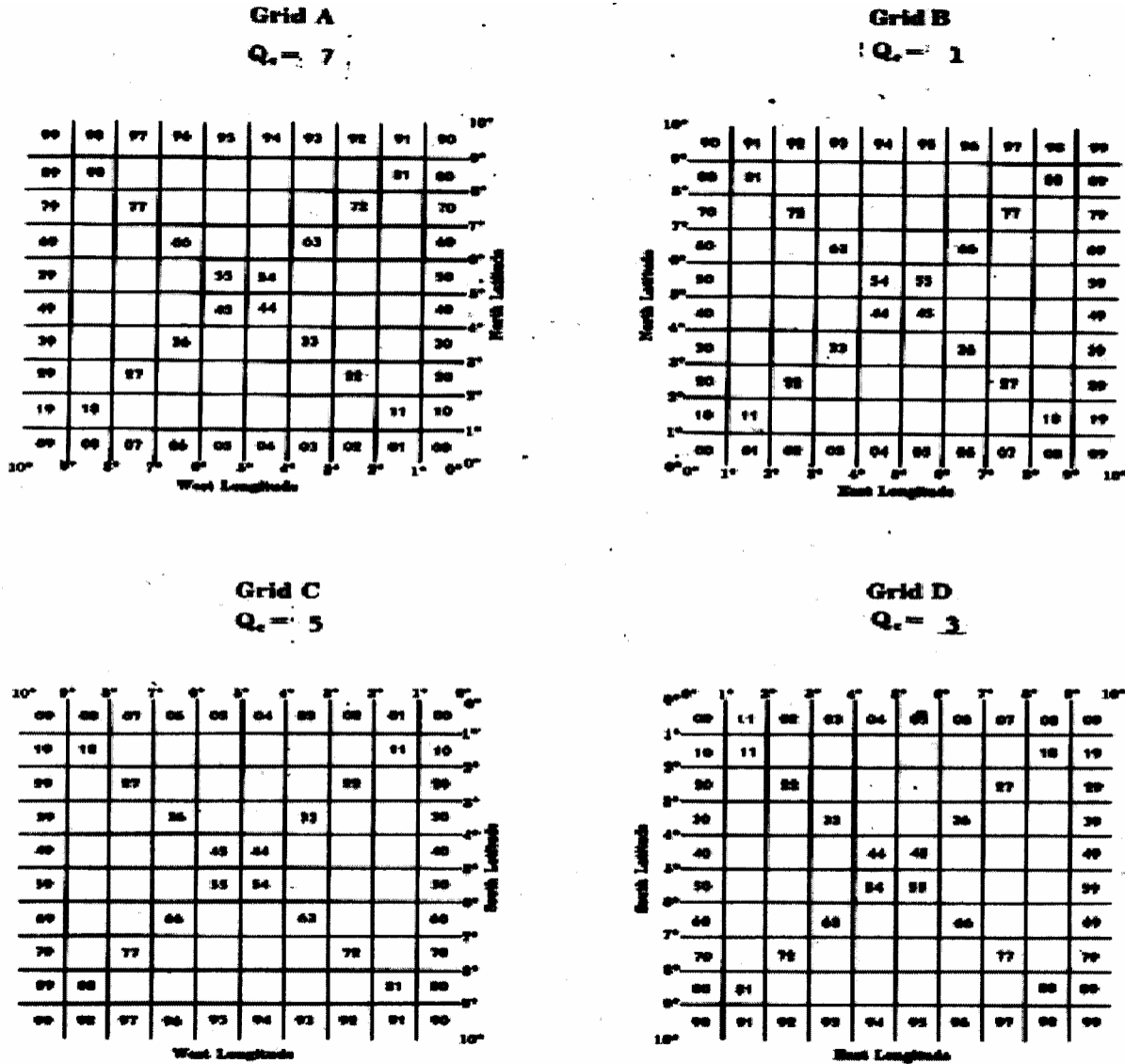


Figure PB-6 Marsden ten degree squares divided into one degree sub squares

2.4.3 MOBILE LAND STATIONS

2.4.3.1 INTRODUCTION

Situations arise in which an aerological ascent is required from a location other than a fixed site. The hardware used to perform the ascent is identical to a fixed land station however the coding of the messages generated contains differences.

2.4.3.2 SECTION 1 : Coding**A) LOCATION - LATITUDE 99L_aL_aL_a**

99 : This is the group identifier;

L_aL_aL_a : These three digits represent the latitude of the point of observation. The latitude is reported in tens, units and tenths of degrees (e.g. 74.15 N is coded as 741).

B) LOCATION - LONGITUDE Q_cL_oL_oL_o

Q_c : Represents the quadrant of the globe where the point of observation is located (refer to Table 2-8). If the mobile land station is located on the equator or a prime meridian, two possible values occur, either one of which is acceptable;

L_oL_oL_oL_o : These digits represent the longitude of the point of observation. The longitude is reported in hundreds, tens, units and tenths of degrees.(e.g. 103.65 is coded as 1036).

WMO Table 3333

| LATITUDE | LONGITUDE | Q _c |
|----------|-----------|----------------|
| North | East | 1 |
| South | East | 3 |
| South | West | 5 |
| North | West | 7 |

Table 2-9 Values of Q_c in each quadrant of the earth**NOTE**

The choice is left to the observer in the following cases :

- When the mobile land station is on the Greenwich meridian or 180th Meridian (L_oL_oL_oL_o = 0000 or 1800 respectively)
 - Q_c = 1 or 7 (Northern Hemisphere) or
 - Q_c = 3 or 5 (Southern Hemisphere)
- When the mobile land station is on the equator (L_aL_aL_a = 000)
 - Q_c = 1 or 7 (Eastern Longitude) or
 - Q_c = 3 or 5 Western Longitude)

C) LOCATION - LAND MMMU_{L_a}U_{L_o}

This is the ship position verification group and is used to check the position of the mobile land station messages.

MMM : This represents the Marsden square number in which the mobile land station is located at the time of observation. The Marsden square number is determined from Figure PB-5 by using the latitude and longitude corresponding to the mobile land station's position (e.g. If the mobile land station's position is 46.0 N and 146.1 W, the Marsden square number is 159);

U_{La} : This is the units digit from the latitude corresponding to mobile land station's position. (e.g. If the latitude is 45.9 N, U_{La} is coded as 5);

U_{Lo} : This is the units digit from the longitude corresponding to the mobile land station's position (e.g. if the longitude is 145 W, U_{Lo} is coded as 5).

D) Elevation Land h_oh_oh_oh_oi_m

h_oh_oh_oh_o : indicates elevation of the station including units of elevation.

i_m : indicates accuracy of the elevation.

2.5 PILOT MESSAGE

2.5.1 SECTION 1

The purpose of section 1 is to identify the type, origin and time of the message, and is included in each PART.

2.5.1.1 MESSAGE INDICATOR M_iM_iM_jM_j

This four letter group contains identification data and is the first group in the coded message.

M_iM_i : The symbolic code for identifying a rawinsonde or radiosonde message originating from a land or ship station A PILOT message is coded as PP and a PILOT SHIP is coded as QQ.

M_jM_j : The symbolic code for identifying the PART of the message that is to follow (i.e.PARTS A, B, C or D). PART B is coded as BB and PART D is coded as DD.

2.5.1.2 DATE INDICATOR YYGG_{a4}

YY : Identifies the day of the month and the unit of wind speed (i.e. knots or metres per second) that is used in the message.

The day of the month is reported through the use of code figures 01 to 31 inclusive, where code figure 01 means the 1st day of the month, 02 means 2nd day of the month, etc;

The unit of wind speed is reported as follows : When wind speeds are reported in knots, 50 is added to YY. (Canadian upper air messages always use knots). When wind speeds are reported in metres per second, YY is not modified.

GG : Identifies the time of observation in whole hours UTC, based on the twenty-four hour clock (i.e. 00 to 23). The standard hour of observation, H, is coded for **GG** whenever the release time is within the time range of H-45 to H+29 inclusive, (e.g. if the release time is 2315, **GG** is coded as 00);

if the release time is outside of the range of H-45 to H+29, **GG** is coded to the nearest hour UTC, (e.g. if the release time is 0030, **GG** is coded as 01).

a₄ : Indicates the type of equipment used during the ascent to measure upper winds (refer to Table 2-9, WMO Table 0265).

WMO Table 0265

| Code Figure | Specification |
|--------------------|--------------------------------------------------------------------------------------------------------|
| 0 | Pressure instrument associated with wind measuring equipment |
| 1 | Optical theodolite |
| 2 | Radiotheodolite |
| 3 | Radar |
| 4 | Pressure instrument associated with wind measuring equipment but pressure element failed during flight |
| 5 | VLF – Omega |
| 6 | Loran – C |
| 7 | Wind profiler |
| 8 | Satellite navigation |
| 9 | Reserved |

Table 2-9 Type of measuring equipment used**2.5.1.3 INTERNATIONAL INDEX NUMBER IIIII**

This five figure group constitutes the International Index Number. (Refer to Section 2.3.1.3)

2.5.2 SECTION 4

The purpose of Section 4 is to report wind direction and speed at selected 1000 foot (300 m) intervals above MSL. These intervals are selected along two different sets of criteria and then combined into a single message. The selection criteria are fixed regional levels. These are the following 1000 foot (300 m) levels:

| | | | |
|------|-------|-------|--------|
| 1000 | 8000 | 25000 | 100000 |
| 2000 | 9000 | 30000 | 110000 |
| 3000 | 12000 | 35000 | 140000 |
| 4000 | 14000 | 50000 | |
| 6000 | 16000 | 70000 | |
| 7000 | 20000 | 90000 | |

2.5.2.1 ALTITUDE OF WIND DATA $Xt_nu_1u_2u_3$

X : Indicator figure 9 is reported for altitudes up to but not including 100,000 feet; indicator figure 1 is reported for altitudes at and above 100,000 feet.

t_n : This is the ten thousands digit of the altitude of the levels for which wind data are being reported (e.g. for 9000 feet, t_n would be reported as 0, for 25,000 feet, t_n would be reported as 2);

$u_1u_2u_3$: These are the thousands digits of the wind levels for which wind data are being reported (e.g. for the 12000, 14000 and 16000 foot levels, $u_1u_2u_3$ would be coded as 246).

NOTE

A maximum of three levels can be reported by a $9t_nu_1u_2u_3$ or $1t_nu_1u_2u_3$ group : Each time that the value of t_n changes, another $9t_nu_1u_2u_3$ or $1t_nu_1u_2u_3$ group is added to the message; a $9t_nu_1u_2u_3$ or $1t_nu_1u_2u_3$ group may specify one, two or three levels and be followed by one, two or three wind data (dffff) groups.

A solidus, /, is coded for u_2 and/or u_3 when a second or third wind data group is not included for a given sequence.

2.5.2.2 WIND DATA AT SPECIFIED ALTITUDES ddfff

This group contains wind direction and speed data for the levels reported by the preceding $9t_n u_1 u_2 u_3$ or $1t_n u_1 u_2 u_3$ group.

dd : The hundreds and tens digits of the wind direction;

fff : The first digit represents the units value of the wind direction rounded to the nearest 5. The final two digits represent the tens and units value of the wind speed. If, however, the wind speed is 100 knots or greater, the hundreds digit of the wind speed is added to the value of the first digit.

Examples :

| | | |
|-------|----------------|-----------|
| (I) | Wind direction | 291 |
| | Wind speed | 55 knots |
| | Coded value | 29055 |
| (ii) | Wind direction | 293 |
| | Wind speed | 55 knots |
| | Coded value | 29555 |
| (iii) | Wind direction | 289 |
| | Wind speed | 106 knots |
| | Coded value | 29106 |
| (iv) | Wind direction | 304 |
| | Wind speed | 201 knots |
| | Coded value | 30701 |

2.6 PILOT SHIP MESSAGE

The PILOT SHIP message is identical to the PILOT message with the exception of section 1. In the case of the PILOT SHIP message, the llll group of the PILOT message is replaced by the $99L_a L_a L_a Q_c L_o L_o L_o L_o M M M U_{L_a} U_{L_o}$ group. These groups are coded in the same manner as in the TEMP SHIP message (refer to par. 2.4.1.1 and 2.4.1.2).

2.7 MISSING DATA

Missing data are reported in aero logical messages through the use of the solid (/).

2.7.1 MANDATORY LEVELS FOR A TEMP OR TEMP SHIP MESSAGE

When data for a mandatory level are missing, but are available for a higher mandatory level, the missing data for that level are coded as solid. Note that the level indicator remains unchanged.

2.7.2 SIGNIFICANT LEVELS IN A TEMP MESSAGE

A stratum of missing data in PARTS B or D of the TEMP (or TEMP SHIP) message is reported by assigning solid to the temperature, dew point depression and wind data for a level within the stratum of missing data. The levels immediately before and after this level are therefore the boundary levels of the missing data stratum.

2.7.3 FIXED REGIONAL AND SIGNIFICANT LEVELS IN A PILOT MESSAGE

A stratum of missing data in a PILOT (or PILOT SHIP) message is reported by assigning solid to the wind direction and speed data for a level within a stratum of missing data. The levels immediately before and immediately after this level are therefore the boundary levels of the missing data stratum.

2.7.4 SPECIAL CIRCUMSTANCES

Other rules for the reporting of missing data are as follows :

- Solids are not included for missing wind data groups for mandatory levels in the TEMP or TEMP SHIP beyond the highest level specified by l_d (refer to bottom of par. 2.3.1.2);
- if a stratum of missing data prevents identification of a tropopause, the five-figure group is coded as 88999;
- if a stratum of missing data prevents identification of a maximum wind, the five figure group is 4 coded as 77999;
- with the Navaid system, dew point temperature evaluation does not cease because of cold temperatures.

PILOT OR PILOT SHIP - UPPER WIND MESSAGE FIRST TRANSMISSION

(Data up to and including 100 hPa)

PART B

Section 1

| | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| M _i M _i M _j M _j or M _i M _i M _j M _j Q _c L _o L _o L _o L _o | YYGG _{a4} YYGG _{a4} MMMU _{La} U _{Lo} | lliii 99L _a L _a L _a | (Identification groups for land stations) (Identification-position groups for ship stations) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|

Section 4

| | | |
|--------------------------------------------------|-------------------|-----------------------------------------|
| 9t _{nu} 1 _u 2 _u 3 | ddfff ddfff ddfff | (Fixed regional and significant levels) |
| 9t _{nu} 1 _u 2 _u 3 | ddfff ddfff ddfff | |

Figure PB-7 Symbolic code forms of PART B (UG) of the first transmission of an upper wind message for land and ship stations

PILOT OR PILOT SHIP - UPPER WIND MESSAGE SECOND TRANSMISSION

(Data above 100 hPa)

PART D

Section 1

| | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| M _i M _i M _j M _j or M _i M _i M _j M _j Q _c L _o L _o L _o L _o | YYGG _{a4} YYGG _{a4} MMMU _{La} U _{Lo} | lliii 99L _a L _a L _a | (Identification groups for land stations) (Identification-position groups for ship stations) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|

Section 4

| | | |
|--------------------------------------------------|-------------------|-----------------------------------------|
| 9t _{nu} 1 _u 2 _u 3 | ddfff ddfff ddfff | (Fixed Regional and Significant Levels) |
| 9t _{nu} 1 _u 2 _u 3 | ddfff ddfff ddfff | |
| 1t _{nu} 1 _u 2 _u 3 | | |

Figure PB-8 Symbolic code forms of PART D (UQ) of the second transmission of an upper wind message for land and ship stations.

2.8 Examples of Coded Messages

PART A

| Symbolic Form Of Group | Pressure Of Mandatory Levels (hPa) | Data to be Reported | | | | | Code Figure For T _a , T _o , T _{ao} | Coded Groups |
|-----------------------------------------------------------------------------|------------------------------------|-----------------------------------------------|----------------|-------------------------|--------------------------|--------------------|-------------------------------------------------------------------|--------------|
| | | Geopotential Height of Mandatory Levels (gpm) | Temperature °C | Dew-Point Depression °C | Wind Direction (degrees) | Wind Speed (Knots) | | |
| M _i M _i M _i M _j | - | - | - | - | - | - | - | 72934 |
| YYGGI _d | - | - | - | - | - | - | - | 72121 |
| lliii | - | - | - | - | - | - | - | 72934 |
| 99P ₀ P ₀ P ₀ | 993.3 | - | - | - | - | - | - | 99993 |
| T ₀ T ₀ T _{ao} D ₀ D ₀ | - | - | +06.0 | 1.0 | - | - | 0 | 06010 |
| d ₀ d ₀ f ₀ f ₀ f ₀ | - | - | - | - | 010 | 02 | - | 01002 |
| oohhh | 1000 | 146 | - | - | - | - | - | 00146 |
| TTT _a DD | - | - | - | - | - | - | - | //// |
| ddfff | - | - | - | - | - | - | - | //// |
| 92hhh | 925 | 826 | - | - | - | - | - | 92826 |
| TTT _a DD | - | - | +04.9 | 2.7 | - | - | 9 | 04927 |
| ddfff | - | - | - | - | 185 | 06 | - | 18506 |
| 85hhh | 850 | 1490 | - | - | - | - | - | 85490 |
| TTT _n DD | - | - | +04.2 | 7.3 | - | - | 2 | 04273 |
| ddfff | - | - | - | - | 235 | 09 | - | 23509 |
| 70hhh | 700 | 3034 | - | - | - | - | - | 70034 |
| TTT _a DD | - | - | -08.9 | 0.3 | - | - | 9 | 08903 |
| ddfff | - | - | - | - | 247 | 20 | - | 24520 |
| 50hhh | 500 | 5558 | - | - | - | - | - | 50556 |
| TTT _n DD | - | - | -26.4 | 15.1 | - | - | 4 | 26565 |
| ddfff | - | - | - | - | 255 | 30 | - | 25530 |
| 40hhh | 400 | 7141 | - | - | - | - | - | 40714 |
| TTT _n DD | - | - | -35.9 | 10.1 | - | - | 9 | 35960 |
| ddfff | - | - | - | - | 257 | 44 | - | 25544 |
| 30hhh | 300 | 9079 | - | - | - | - | - | 30908 |
| TTT _a DD | - | - | -50.1 | missing | - | - | - | 501// |
| ddfff | - | - | - | - | 253 | 45 | - | 25545 |
| 25hhh | 250 | 10257 | - | - | - | - | - | 25026 |
| TTT _a DD | - | - | -52.1 | missing | - | - | 1 | 521// |
| ddfff | - | - | - | - | 251 | 42 | - | 25042 |
| 20hhh | 200 | 11706 | - | - | - | - | - | 20171 |
| TTT _a DD | - | - | -49.7 | missing | - | - | 7 | 497// |
| ddfff | - | - | - | - | 236 | 35 | - | 23535 |
| 15hhh | 150 | 13599 | - | - | - | - | - | 15360 |
| TTT _a DD | - | - | -47.3 | missing | - | - | 3 | 473// |
| ddfff | - | - | - | - | 247 | 23 | - | 24523 |
| 10hhh | 100 | 16278 | - | - | - | - | - | 10628 |
| TTT _a DD | - | - | -50.5 | missing | - | - | 5 | 505// |
| ddfff | - | - | - | - | 222 | 13 | - | 22013 |
| 88P _t P _t P _t | 273 | - | - | - | - | - | - | 88273 |
| T _t T _t T _{at} D _t D _t | - | - | -54.7 | missing | - | missing | 7 | 547// |
| d _t d _t f _t f _t f _t | - | - | - | - | 253 | 46 | - | 25546 |
| 77P _m P _m P _m | - | - | - | - | missing | missing | - | 77999 |

Figure PB-9 Example of data reported for PART A (US) of the TEMP message

PART B

| Symbolic Form Of Group | Level Number | Data to be Reported | | | | Code Figure For T _a T _{ao} ,T _{ao} | Coded Groups |
|-----------------------------------------------------------------------------|--------------|---------------------|----------------|-------------------------|---|-----------------------------------------------------------------|--------------|
| | | Pressure (hPa) | Temperature °C | Dew-Point Depression °C | | | |
| M _i M _i M _i M _j | - | - | - | - | - | TTBB | |
| YYGG/ | - | - | - | - | - | 7212/ | |
| lllll | - | - | - | - | - | 72934 | |
| 00P ₀ P ₀ P ₀ | 00 | 993.3 | - | - | - | 00993 | |
| T ₀ T ₀ T _{ao} D ₀ D ₀ | - | - | +0.60 | 1.0 | 0 | 06010 | |
| 11PPP | 11 | 976 | - | - | - | 11976 | |
| TTT _a DD | - | - | +11.2 | 11.6 | 2 | 11262 | |
| 22PPP | 22 | 968 | - | - | - | 22968 | |
| TTT _a DD | - | - | +10.8 | 8.4 | 8 | 10858 | |
| 33PPP | 33 | 928 | - | - | - | 33928 | |
| TTT _a DD | - | - | +9.5 | 12.4 | 4 | 09462 | |
| 44PPP | 44 | 910 | - | - | - | 44910 | |
| TTT _n DD | - | - | +8.2 | 7.1 | 2 | 08257 | |
| 55PPP | 55 | 814 | - | - | - | 55814 | |
| TTT _n DD | - | - | +01.6 | 7.6 | 6 | 01658 | |
| 66PPP | 66 | 793 | - | - | - | 66793 | |
| TTT _n DD | - | - | +00.0 | 1.7 | 0 | 00017 | |
| 77PPP | 77 | 690 | - | - | - | 77690 | |
| TTT _a DD | - | - | -09.9 | 0.1 | 9 | 09901 | |
| 88PPP | 88 | 678 | - | - | - | 88678 | |
| TTT _a DD | - | - | -10.6 | 6.7 | 7 | 10757 | |
| 99PPP | 99 | 656 | - | - | - | 99656 | |
| TTT _a DD | - | - | -10.8 | 14.6 | 9 | 10965 | |
| 11PPP | 11 | 482 | - | - | - | 11482 | |
| TTT _a DD | - | - | -28.6 | 15.2 | 7 | 28765 | |
| 22PPP | 22 | 466 | - | - | - | 22466 | |
| TTT _a DD | - | - | -28.8 | 14.5 | 9 | 28965 | |
| 33PPP | 33 | 370 | - | - | - | 33370 | |
| TTT _a DD | - | - | -39.9 | 9.8 | 9 | 39960 | |
| 44PPP | 44 | 273 | - | - | - | 44273 | |
| TTT _a DD | - | - | -54.7 | missing | 7 | 547// | |
| 55PPP | 55 | 195 | - | - | - | 55195 | |
| TTT _a DD | - | - | -48.7 | missing | 7 | 487// | |
| 66PPP | 66 | 124 | - | - | - | 66124 | |
| TTT _a DD | - | - | -46.3 | missing | 3 | 463// | |
| 77PPP | 77 | 100 | - | - | - | 77100 | |
| TTT _a DD | - | - | -50.4 | missing | 5 | 505// | |
| 31313 | - | - | - | - | - | - | |
| S _r r _a r _a S _a S _a | - | - | - | - | - | - | |
| 8GGgg | - | - | - | - | - | - | |
| (9S _n T _w T _w T _w) | - | - | - | - | - | - | |

Figure PB-10 Example of data reported for PART B (UK) of the TEMP message

PART C

| Symbolic Form of Group | Pressure of Mandatory levels (hPa) | Data to be Reported | | | | | | Coded Groups |
|-----------------------------------------------------------------------------|------------------------------------|-------------------------------------|----------------|-------------------------|--------------------------|--------------------|--------------------------------|--------------|
| | | Geopotential Height of Levels (gpm) | Temperature °C | Dew-Point Depression °C | Wind Direction (degrees) | Wind Speed (knots) | Code Figure for T _a | |
| M _i M _i M _i M _j | - | - | - | - | - | - | - | TTCC |
| YYGGI _d | - | - | - | - | - | - | - | 72121 |
| lliii | - | - | - | - | - | - | - | 72934 |
| 70hhh | 70 | 18591 | - | - | - | - | - | 70859 |
| TTT _a DD | - | - | 52.2 | missing | - | - | 3 | 523// |
| ddfff | - | - | - | - | 162 | 05 | - | 16005 |
| 50hhh | 50 | 20777 | - | - | - | - | - | 50078 |
| TTT _a DD | - | - | -50.4 | missing | - | - | 5 | 505// |
| ddfff | - | - | - | - | 0.93 | 06 | - | 09506 |
| 30hhh | 30 | 24118 | - | - | - | - | - | 30412 |
| TTT _a DD | - | - | 50.0 | missing | - | - | 1 | 501// |
| ddfff | - | - | - | - | 088 | 13 | - | 09013 |
| 20hhh | 20 | 26788 | - | - | - | - | - | 20679 |
| TTT _a DD | - | - | 46.7 | missing | - | - | 7 | 467// |
| ddfff | - | - | - | - | 080 | 13 | - | 08013 |
| 10hhh | 10 | 31457 | - | - | - | - | - | 10146 |
| TTT _a DD | - | - | -37.6 | missing | - | - | 7 | 377// |
| ddfff | - | - | - | - | 072 | 18 | - | 07018 |
| 07hhh | 7 | 33949 | - | - | - | - | - | 07395 |
| TTT _a DD | - | - | 31.2 | missing | - | - | 3 | 313// |
| ddfff | - | - | - | - | missing | missing | - | //// |
| 88P _t P _t P _t | 86 | - | - | - | - | - | - | 88860 |
| T _t T _t T _{at} D _t D _t | - | - | 53.3 | missing | - | - | 3 | 533// |
| d _t d _t f _t f _t | - | - | - | - | 205 | 13 | - | 20513 |
| 77P _m P _m P _m | - | - | - | - | - | - | - | 77999 |

Figure PB-11 Example of data reported for PART C (UL) of the TEMP message

PART D

| Symbolic Form of Group | Level Number | Data to be Reported | | | Code Figure for T _a | Coded Groups |
|-------------------------------------------------------------|--------------|------------------------------|----------------|-------------------------|--------------------------------|--------------|
| | | Pressure (hPa) | Temperature °C | Dew-Point Depression °C | | |
| M _i M _i M _j M _j | - | - | - | - | - | TTCC |
| YYGG/ | - | - | - | - | - | 7212/ |
| lliii | - | - | - | - | - | 72934 |
| 11PPP | 11 | 93 | - | - | - | 11930 |
| TTT _a DD | - | - | -48.7 | missing | 7 | 487// |
| 22PPP | 22 | 86 | - | - | - | 22860 |
| TTT _a DD | - | - | -53.3 | missing | 3 | 533// |
| 33PPP | 33 | 40 | - | - | - | 33400 |
| TTT _a DD | - | - | -49.3 | missing | 3 | 493// |
| 44PPP | 44 | 31 | - | - | - | 44310 |
| TTT _a DD | - | - | -50.3 | missing | 3 | 503// |
| 55PPP | 55 | 14 | - | - | - | 55140 |
| TTT _a DD | - | - | -43.9 | missing | 9 | 439// |
| 66PPP | 66 | 6 | - | - | - | 66060 |
| TTT _a DD | - | - | -28.5 | missing | 5 | 285// |
| 51515 | - | - | - | - | - | 51515 |
| 101A _{df} A _{df} | - | - | - | - | - | 10190 |
| PPhhh | - | 5 (altitude 36365 gpm) | - | - | - | 05637 |

Figure PB-12 Example of data recorded for PART D (UE) of the TEMP message

PART B

| Symbolic Form Of Group | Data to be Reported | | | | Code Figure For Ta | Coded Group |
|-------------------------------------------------------------|---------------------|--------------------------------|----------------|-------------------------|--------------------|-------------|
| | Level Number | Pressure (hPa) | Temperature 0C | Dew-Point Depression 0C | | |
| M _i M _i M _i M _j | - | - | - | - | - | TTDD |
| YYGG/ | - | - | - | - | - | 7212/ |
| lliii | - | - | - | - | - | 72934 |
| IIPPP | 11 | 93 | - | - | - | 11930 |
| TTT _a DD | - | - | -48.7 | missing | 7 | 487// |
| 22PPP | 22 | 86 | - | - | - | 22860 |
| TTT _a DD | - | - | -53.3 | missing | 3 | 533// |
| 33PPP | 33 | 40 | - | - | - | 33400 |
| TTT _a DD | - | - | -49.3 | missing | 3 | 493// |
| 44PPP | 44 | 31 | - | - | - | 44310 |
| TTT _a DD | - | - | -50.3 | missing | 3 | 503// |
| 55PPP | 55 | 14 | - | - | - | 55140 |
| TTT _a DD | - | - | -43.9 | missing | 9 | 439// |
| 66PPP | 66 | 6 | - | - | - | 66060 |
| TTT _a DD | - | - | -28.5 | missing | 5 | 285// |
| 51515 | - | - | - | - | - | 51515 |
| 101A _{df} A _{df} | - | - | - | - | - | 10190 |
| PPhhh | - | 5 (altitude - 36365 gpm) | - | - | - | - |

Figure PB-13 Example of data reported for PART B (UG) of the PILOT message

PART D

| Symbolic Form of Group | Data to be Reported | | | Coded Groups |
|-------------------------------------------------------------|---------------------|--------------------------|--------------------|--------------|
| | Altitude (feet) | Wind Directory (degrees) | Wind Speed (knots) | |
| M _i M _i M _i M _j | | | | PPDD |
| YYGG _{a4} | | | | 59000 |
| lliii | | | | 72600 |
| 9t _n ^{u u u} _{1 2 3} | | | | 954// |
| ddfff | 54,000 | 278 | 41 | 28041 |
| 9t _n ^{u u u} _{1 2 3} | | | | 96248 |
| ddfff | 62,000 | 299 | 17 | 30017 |
| ddfff | 64,000 | 326 | 13 | 32513 |
| ddfff | 68,000 | 312 | 09 | 31009 |
| 9t _n ^{u u u} _{1 2 3} | | | | 9704/ |
| ddfff | 70,000 | 316 | 06 | 31506 |
| ddfff | 74,000 | 343 | 03 | 34503 |
| 9t _n ^{u u u} _{1 2 3} | | | | 98369 |
| ddfff | 83,000 | 343 | 03 | 34503 |
| ddfff | 86,000 | 099 | 06 | 10006 |
| ddfff | 89,000 | 109 | 07 | 11007 |

Figure PB-14 Example of data reported for PART D (UQ) of the PILOT message

CHAPTER 1

STANDARD OPERATING FLIGHT PROCEDURES

1.1 INTRODUCTION

The aerological sounding consists of 3 segments :

- (1) Pre-flight,
- (2) in-flight,
- (3) post flight.

The sequence in which most procedures must be performed is identical for all soundings; however, the order of certain tasks may vary depending on the station's operational programs and requirements. The "Official Time of Observation" refers to the actual time of release as determined by the Meteorological Service of a particular country. By international agreement, this time will fall between H-45 minutes and H, where H equals any of the four main synoptic hours (00:00, 06:00, 12:00, 18:00 UTC). The M.S.C. has chosen a time of H-45 for the morning and evening release, therefore, the official times of observation are 11:15 UTC and 23:15 UTC.

1.2 Pre-Flight Procedures

1.2.1 Introduction

Pre-flight procedures are defined as any duty, which must be accomplished up to and including the balloon launch. These duties normally take place between the times of 10:00 and 11:15 UTC for the morning observation or 22:00 and 23:15 UTC for the evening observation. The main stages of the pre-flight routine are as follows :

1. System power-up,
2. PC power-up,
3. radiosonde inspection,
4. balloon inflation,
5. radiosonde power-up,
6. calibration co-efficients,
7. signal check,
8. ground check,
9. acclimatization,
10. release preparations,
11. release.

1.2.2 System Power Up

The DigiCORA MW15 rawinsonde set is essential to the aerological sounding, therefore it is futile to proceed with any other pre-flight operations before it is checked for proper operation. Confirm the system is in “stand-by” mode by checking the front panel. Confirm the (amber) light is ON then depress the “**ON**” push button; confirm the (green) “Power” light is ON. The system will respond with a series of messages :

- (1) Sounding Processor Power - up test in progress.
- (2) System Test Continues. Console test OK.
- (3) PPCS Test Passed - OK. System Diagnostics in progress.

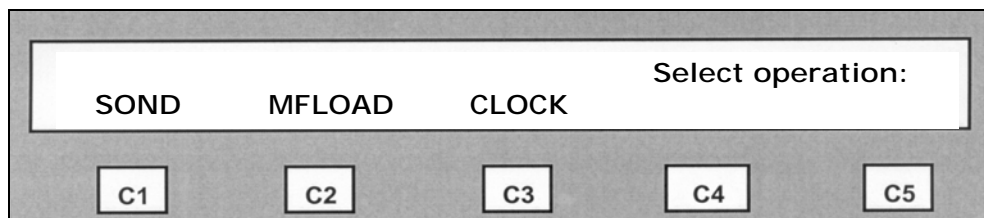
The completion of the self-diagnostics process will be indicated by the text :

```
"Start Up Date 22 Sep 02 10:11 UTC. System test passed  
- No errors found".
```

Immediately following the above message the display will show the Date/Time with the option to either Accept or Reject. If the Date/Time is correct press **C4** Accept. If the Day, Month, Year, Hour or Minute need to be corrected press **C5** Reject.

When Reject (**C5**) is selected the process for correcting the data is as follows :

1. The display will prompt to input the last 2 digits of the current Julian year (YY) (i.e. 2002=02 2003=03 etc.)
2. The display will prompt for the month (MM) (e.g. January=01, February=02 etc.)
3. The display will prompt for the day (DD), hour (hh), and minute (mm). When entering the day for the evening flight, the day of the flight is not entered e.g. if it is on the evening of September 21 (22/0000 UTC) the input will be 21 as the correct time is still before midnight.
4. Once all the date/time parameters recorded, the display will again respond with a date/time display.
5. When the correct time rolls over to the exact minute that was input press **C4** Accept to accept the changes.
6. The system will respond with the display below and it is left in this state while the procedures continue.



1.2.3 PC Power Up

The “boot-up” of the PC will normally end with a display of the Microsoft Windows’95 “Desktop”. If errors are found, you will be alerted of such and must follow the instructions provided until “Scandisk” finds and repairs the errors. An AMS discrepancy report will have to be completed at the end of the sounding, as per section 3.1.3.2. Once the PC has “booted-up”, the date and time setting must be verified. The Windows’95 Desktop will normally display a small digital clock in the extreme bottom right hand corner of the screen. Place the mouse over the clock, “right- click” once and select **Adjust Date/Time**. The “Date/Time Properties” window will appear. The “Time Zone” tab is not normally accessed by the observer. The time zone is set to **(GMT) Monrovia, Casablanca** upon installation and should not be changed or some of the aerological software may not function properly. The “Date & Time” tab shows the month, year, calendar day and time. Each may be adjusted using the mouse. The time is usually displayed using a “12 hour clock”. As soon as the hour (hh), minutes (mm), seconds (ss) or the AM/PM are highlighted and changes are made, the clock will stop and may then be adjusted.

1.2.4 Radiosonde Inspection

The radiosonde selected for the flight must now undergo preliminary inspection before use. Careful preparation and visual inspection of the instrument is needed in order to detect any defects prior to release. There are several criteria that must be satisfied during the preliminary inspection or the radiosonde must be rejected.

1. Tear the edge of the radiosonde envelope and remove the radiosonde.
2. Remove the calibration tape and compare the serial number printed on the tape label with that of the radiosonde. Record the radiosonde serial number in the Ground Check Log. Reject the instrument if the serial numbers do not match.
3. Unfold and straighten the transmitter antenna. The antenna must point straight down during the sounding to ensure optimum signal strength.
4. Unwind the Navaid antenna from the de-reeler (FH and LH types). Reject the instrument if the ground wire (wrapped around the antenna) is broken.
5. Open the flap covering the battery compartment and carefully bend the sensor arm slightly upwards.
6. Remove the sensor arm’s protective shield. Inspect the thermistor and hygistor cap. Reject the radiosonde if either sensor is damaged or soiled.

CAUTION

Do not touch the thermistor or the hygistor cap. (Refer to Appendix 2)

7. Remove the battery package from the radiosonde compartment. Cut the envelope with scissors and remove the battery. Reject the battery if it is damaged or wires are broken.
8. Set the radiosonde, the battery and battery envelope on a dry surface and prepare to inflate the balloon.

1.2.5 Balloon Inflation

1.2.5.1 Introduction

The observer should decide prior to beginning the inflation if increased lift will be required to overcome strong surface winds, precipitation, weight of the radiosonde or expected icing. Sufficient time should be allotted to permit a careful and methodical inflation routine. The balloon should not be inflated more than 45 minutes prior to release. Do not overfill the balloon. Use the minimum amount of lift required to produce an ascent rate between 250 and 325 m/min. The rate of inflation should be such that it takes a minimum of 10 minutes to complete the procedure. As a general rule, the inflation should take 1 minute for each 100 grams of lift required.

1.2.5.2 Hydrogen Gas

In order to detect balloon leaks or defects and to avoid overfilling the balloon, do not leave the immediate area or perform any other duties during balloon inflation.

1. Clean/sweep the inflation table and check for damaged surfaces.
2. Check the balloon filler frame and nozzle for proper grounding.
3. Ensure the weight hanger is attached to the nozzle and verify the amount of weight contained is appropriate for the sounding.
4. Attach the balloon neck to the nozzle, secure the clamp and unfold the balloon carefully.
5. Open the overhead door slightly (weather permitting) to increase ventilation.
6. CLOSE valve V-7 then OPEN valve V-9.
7. Open the balloon inflation valve slowly.
8. Note the operation of the PDS switch.
9. Examine the balloon for holes/deformations during the inflation and stop at the half-way point to listen for leaks.
10. Continue the balloon inflation until the inflation nozzle rises above the balloon filler frame then promptly close the inflation valve.

OPERATING PROCEDURES

PC5

11. Determine the nozzle lift and record this reading to the nearest 25 grams in the appropriate column of the Electrolyser Operations log.
12. Tie off the balloon in an appropriate manner and secure until release.
13. Observe the pressure as indicated on the storage tank high pressure gauge and record this reading to the nearest 1 psi in the appropriate column of the Electrolyser Operations log.

Additional Information

If a leak or significant defect is discovered in an aerological balloon :

1. Immediately STOP the inflation.
2. Ground yourself in the electrolyser room.
3. Quickly tie off the balloon.
4. Remove the balloon to the exterior of the inflation room.
5. DO NOT RELEASE.
6. If weather permits, tether the balloon with approximately 10 metres of strong rope, in a suitable location (away from the hydrogen building) and allow to deflate completely.
7. If weather conditions do not allow tethering the balloon, hold the balloon by the neck with one hand and tear it open with the other.
8. Dispose of the balloon material in a suitable waste receptacle.

1.2.5.3 Helium Gas

In order to detect balloon leaks or defects and to avoid overfilling the balloon, do not leave the immediate area or perform any other duties during balloon inflation.

1. Clean/sweep the inflation table and check for damaged surfaces.
2. Check the balloon filler frame and nozzle for proper operation.
3. Ensure the weight hanger is attached to the nozzle and verify the amount of weight contained is appropriate for the sounding.
4. Attach the balloon neck to the nozzle, secure the clamp and unfold the balloon carefully.
5. Check the helium supply to ensure it is secure.
6. Install the gas regulator (if applicable).
7. Ensure the gas regulator valve is closed.
8. Open the helium cylinder main valve and note the reading on the high pressure gauge.

OPERATING PROCEDURES

PC6

9. Open the gas regulator slowly.
10. Examine the balloon for holes/defects during the inflation and stop at the half-way point to listen for leaks (reject the balloon if necessary).
11. Continue the balloon inflation until the nozzle rises above the balloon filler frame (minimum 10 minutes) then promptly close the gas regulator.
12. Determine the nozzle lift and record this reading to the nearest 25 grams in the appropriate log.
13. Tie off the balloon in an appropriate manner and secure until release.
14. Close the helium cylinder main valve.
15. Bleed the excess helium from the regulator.
16. Remove the gas regulator (if applicable).
17. Ensure a clean work area and dispose of balloon box, bag, etc.

1.2.6 Radiosonde Power Up

1.2.6.1 Introduction

Powering up the radiosonde consists of activating, connecting and installing the battery in the radiosonde compartment then placing the instrument in the “Ground Check Box”. When properly activated, the battery should provide reliable operation for approximately 4 hours. The battery activation should not be performed more than 30 minutes prior to release (H-1:15). On warm days (>20°C) or when using a GPS radiosonde, it is not advisable to prepare the battery sooner than 15 minutes prior to release as the battery may overheat. The water used to activate the battery must be clean and at room temperature (15°C to 25°C).

1.2.6.2 Activation

1. Immerse the battery in (clean/room temperature) water for 3 minutes.
2. Remove the battery and shake off excess water.

CAUTION

Do not press water out of the battery, this will shorten its life.

3. Verify the battery power with a battery tester or multimeter. Observe and record the battery power in the Ground Check Log. Reject the battery if the power is not at least 15 volts.

CAUTION

Set a rejected battery outdoors to cool off prior to disposal.

OPERATING PROCEDURES

PC7

4. Connect the battery to the radiosonde, being careful to observe polarity.
5. Install the battery in the radiosonde battery compartment WAXED END DOWN. This will prevent the battery from losing too much moisture during the sounding.

CAUTION

Be careful not to “contaminate” the hygistor with water during the battery installation. Ensure the area near the radiosonde as well as your hands, are dry.

6. Install the foam cover, close the paper flap and secure it with a small piece of tape.
7. Place the radiosonde in the ground check box with the sensor boom sealed in the desiccant chamber.

1.2.7 Calibration Co-Efficients

1. Once the radiosonde has acclimatized in the ground check box (1 minute) press **C1 SOND** on the system display. The “Sounding Program” will start.
2. After the sounding program has loaded the system will prompt you to select a “Wind Finding Method”. Ensure your selection is compatible with the radiosonde type you have chosen for the sounding.
3. The program will then prompt you to run the calibration tape through the system optic reader. Insert the calibration tape through the tape entry slots from right to left as shown on the front panel of the system.

CAUTION

Run the tape only up to the printed label then remove it by pulling back from left to right. Inserting the printed label through the optic reader may cause damage. Also be careful not to damage the tape, as the optic reader is also sensitive to tape irregularities. Immediately after the calibration tape has been run, the system will respond with one of two possible messages :

- Coefficients OK: The coefficients have been accepted.
- Tape read error: The coefficients have been rejected.

OPERATING PROCEDURES

PC8

The system will prompt to insert the tape once more. Check the calibration tape for damage or obstructed holes then try to run the tape faster or slower than the first attempt. If this is unsuccessful the calibration co-efficients will have to be entered manually.

4. Press **C5** and use the data entry keypad.
5. The system will ask you if the radiosonde you are using is an RS80 or Special. Press **C3** Special.

NOTE

“Special” indicates an RS80 radiosonde with an H-type “Humicap” (hygristor cap) sensor.

6. The system will prompt to enter the full set of numbers as listed on the calibration tape printed label, starting with the radiosonde serial number. Key in the serial number using the data entry keypad then press **ENTER**.
7. The system will prompt for the first coefficient of group **P**. Input the **PY0** value and press **ENTER**. This will be followed by **P0**, **P1**, **P2**, etc.

CAUTION

Observe the minus signs.

The last number of group **P** to be input is the **CS** (checksum). The checksum validates the group **P** numbers you have entered. If you have made an error, the system will display a warning message. If an error is made the system will display the numbers entered, one by one. Each **P** value must be verified by an **Accept** or **Reject** until the error is found.

NOTE

The error may be introduced by entering a wrong **CS** value as well.

If no error is made during manual input of the **P** group and the **CS** value, the system will prompt to enter the first number in group **D** (i.e. **DY0**). Continue with each group in the same manner until the system indicates the coefficients have been entered successfully.

Once the calibration has been successfully entered, the system will display one of three possible messages :

- **MONITORING SONDE**

Displayed when the system has detected a radiosonde signal and accepted the PTU data being transmitted. The observer may proceed with the “Telemetry Mode”.

- **DATA OUT OF BOUNDS**

Displayed when the system has detected the radiosonde signal but has determined that the PTU values exceed “reasonable” limits. The observer may restart the MW15 system and re-run the calibration tape. If the result is the same then the observer must exit (**C1 EXIT**) and reject the radiosonde.

- **CHECK TELEMETRY**

Displayed when the system cannot detect a signal. The system will also warn the observer with a series of “beeps”. To mute this warning, Press **CLEAR** on the data entry keypad. The radiosonde must now be “tuned in” using the “Signal Check” procedure.

1.2.8 Signal Check

To tune in the radiosonde signal, select **TELEM** on the OPERATION CONTROL keys. The system will enter “Telemetry Mode”. The display will show several receiver options. Press **C1 SCAN** to “scan” for the radiosonde signal. When a signal is detected, the display will show six different fields :

- (1) Radiosonde frequency display.
- (2) Frequency control : Afc, Scan, Track, Tune dn, Tune up, more. Pressing **C5 More** will display Afc, Antenna, Narrow, Wide.
- (3) Antenna azimuth and elevation; (e.g. N=North).
- (4) Antenna directing mode : Auto=search for best orientation, Man>manual.
- (5) IF bands : Wide=bandwidth of 200 kHz, Narrow=bandwidth of 50 kHz.
- (6) Radiosonde signal strength : Zero to five [*] depending on reception.

OPERATING PROCEDURES

PC10

Press **PTU CHANNEL** and **Δ] VOLUME** when the signal strength indicates 3 to 5 stars. The radiosonde's "filtered" signal will be distinguished as alternating beeps while the P, T and U sensors each record a reading in turn. There should be no noise (RF interference) other than the radiosonde signal.

- A. If the signal strength is not 3 to 5 stars or the PTU Audio is not "clean", press **C1 SCAN** once more.

NOTE

You may wish to press **C3 Tune dn** or **C4 Tune up**. This will serve the same purpose.

- B. If the signal strength or PTU audio quality does not improve, reject the radiosonde. Once the radiosonde is tuned in, observe and record the frequency in the Ground Check Log if it is within ± 1 of 403 MHz.
- C. If the signal strength is acceptable but the frequency is not within ± 1 of 403 MHz, the radiosonde frequency must be adjusted :
 1. Press **C2 Track**. This will suspend the Afc and allow the system to "track" the radiosonde signal as the frequency increases or decreases.

NOTE

Disabling the AFC and enabling the Trck prevents the signal from being lost if the frequency changes rapidly. Track is similar to Scan but operates quicker and with a wider search range.

2. Turn the radiosonde's frequency adjusting screw
3. Observe the system display and note the frequency as it changes during the adjustment.
4. When the desired frequency is displayed, press **C2 Track** again and the Afc will be enabled. Record the new frequency in the Ground Check Log.
5. Verify the "Antenna Directing" is in "Auto" mode
6. Exit the telemetry mode by pressing **TELEM** on the operation control keys. The MW15 will begin to "monitor" the radiosonde.

After the calibration coefficients have been entered and the sonde is being monitored, the system will locate the Navaid signals required for wind computation. Either VLF, Loran-C or GPS Navaid transmitters will be “synchronized”, depending on the wind finding method previously selected. When the selected Navaid signals are synchronized, the system will respond with a flashing message in the system display (eg. VLF Synchronized). The loudspeaker will beep 3 to 5 times. This process may take up to 12 minutes. If after a time the system is unable to synchronize the necessary signals, a warning message will appear. Press **C4 WAIT**. The system will return to the monitoring sonde display. If the warning message appears once again and time constraints do not permit waiting, press **C5 GO ON**.

1.2.9 Ground Check

The ground check will ensure that the radiosonde satisfies the criteria for accuracy, as established by the MSC. The acceptable limits or “tolerances” for PTU values are :

- (1) Pressure 5.0 hPa (compared to the station barometer);
- (2) temperature ± 2.0 °C (compared to the ground check box thermometer);
- (3) humidity ± 5 % (compared to the ground check box chamber 0%).

In other words, the PTU values displayed by the system may not deviate by more than the tolerances listed above. If these limits are exceeded, the radiosonde must be set aside and re-checked by a second observer.

If the PTU values displayed by the system at the end of the ground check are within limits, reference parameters will be input. Ground Check References (GC_REFs) compensate (correct) minor changes which may have affected the radiosonde sensors during shipping.

The temperature (thermistor) and humidity (hygristor) sensors are matched at the factory therefore these readings must not be changed. The pressure reading is normally the only parameter for which a correction is made during the ground check.

- (1) The pressure, observed on the station barometer will “rule” over the pressure displayed by the system pressure, shall be corrected.
- (2) The temperature observed on the ground check box thermometer will not rule over the system temperature. Temperature shall not be corrected.
- (3) The humidity displayed by the system will rule, unless it is negative. The system cannot accept a negative humidity value, therefore 0% will rule in that case. Humidity shall be corrected only if negative.

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To initiate a ground check, hit **C3** GC. After a short period (less than 1 minute), the display will prompt to observe the ground check references.

- (1) Observe and record the station pressure in the Ground Check Log;
- (2) Observe and record the temperature in the Ground Check Log (0% will be taken into account as the humidity observation).

NOTE

If the MW15 system does not prompt to “Read References”, it is an indication that the PTU measurements are being affected and will not stabilize. This may be due to several factors such as a weak signal, improper operating frequency, RF signal interference or even bright sunshine on the ground check box’s desiccant chamber. These possibilities must be checked and ruled out before rejecting the radiosonde.

- (3) Observe and record the PTU display, in the Ground Check Log. Compare the PTU values with your observations and determine if they are within limits as per page PC11. If the PTU values are out of limits, re-check the observations, ensure the ground check box desiccant is dry (blue), press **C3** NEW_GC and go back to step 1. If the “New Ground Check” is not successful, hit **C1** to exit the **SOND** program and reject the radiosonde. At this point a new instrument must be prepared. If all is OK, proceed to step 4.
- (4) Press **C5** GC REFS to record GC references. The MW15 system will respond with what follows below :
- (5) Using the data entry keypad, input the station pressure to the nearest tenth then hit **ENTER**. The MW15 will then prompt for the temperature input.
- (6) Key in the temperature as displayed by the system then press **ENTER**. The MW15 system will prompt for the humidity input.
- (7) Key in the humidity as displayed (unless negative) then hit **ENTER**. When the PTU ground check references (GC REFS) have been input, the MW15 system will display the corrections applied.
- (8) Verify the corrections applied correspond to the PTU values you entered. If not, hit **C3** NEW_GC and return to step 1. If no errors are found, press **C4** ACCEPT.

After the ground check references have been accepted, the system will return to monitoring the radiosonde. If the wind finding method is synchronized, a “*RELEASE” prompt will be displayed and you will no longer have the option to perform a ground check. The MW15 loudspeaker will beep continuously until you hit **CLEAR** on the data entry keypad. If the wind finding method is not synchronized, the MW15 system will return to the “Monitoring Sonde” display.

CAUTION

The MW15 system will not prompt to RELEASE the radiosonde until the Navaid signals are synchronized.

- (9) Remove the radiosonde from the ground check box.
- (10) Observe the room humidity (as displayed by the system) and record this value in the Ground Check Log.
- (11) The radiosonde is now ready for acclimatization.

1.2.10 Acclimatization

An acclimatization period is necessary for the radiosonde to adapt to outdoor conditions. When the difference between the operations room temperature and outdoor temperature exceeds 20 degrees Celsius, the observer must acclimatize the instrument for a minimum of 10 minutes. The recommended location for acclimatization of the radiosonde is a suitably modified Stevenson screen (near the release area). The radiosonde may be taken into the balloon inflation room and secured to the balloon neck as long as it remains in an upright position and is kept away from bright sunshine.

CAUTION

For hydrogen filled balloons, the instrument must remain below the neck of the balloon.

- (1) Transport the radiosonde to the outdoors and acclimatize.
- (2) Verify the operation of the Stevenson screen (i.e. ventilation, wet bulb, ice bulb, etc.).
- (3) Observe the outdoor humidity (as displayed by the system) and record this, value in the Release log.
- (4) Check the telemetry TELEM :
 - i. Verify the signal strength is 3 to 5 stars.
 - ii. Listen to the PTU AUDIO.
 - iii. Observe and record the radiosonde frequency in the Release log.

1.2.11 Release Preparations

Once the radiosonde is outdoors, the observer must verify that no damage or anomalies have occurred to the instrument or sensors during the transition from the operations room to the acclimatization area.

1. GPS Radiosonde only - Exit telemetry **TELEM** and verify the Navaid signal reception by pressing **STATUS** on the OPERATION CONTROL keys.

NOTE

If there are insufficient Navaid signals available, wind data will most likely be missing or doubtful. The status display will show several options, depending on the wind finding method in use.

2. Select the wind finding method in use.

NOTE

When acclimatizing an RS80 15GH (GPS), the radiosonde should remain in an upright position and unobstructed (away from buildings) for a minimum of 1 minute prior to the release. Although the “GPS synchronized” display may have occurred in the pre-flight routine, the GPS module in the radiosonde cannot acquire and provide sufficient satellite Navaid information to the MW15 if it is obstructed or under a “canopy”. If the necessary number of Navaid signals are not indicated by the MW15 status display, the observer must delay the release until sufficient Navaid signals have been acquired. If there are insufficient Navaid signals available and time does not permit waiting (i.e. H-45 to H-31), the observer must release the radiosonde and monitor **Metgraph** for missing wind data.

NOTE

These observations must be recorded in the Flight log and an AMS Discrepancy report must accompany the Routine Flight Information report. If you are unable to obtain synchronized Navaid signals, hit **C5 GO ON** when the “NOT YET SYNCHRONIZED” message is displayed and proceed to step 3. In this case wind data will most likely be missing or doubtful. Once the Navaid status has been checked, return to monitoring the radiosonde by pressing the **STATUS** key twice.

3. Ensure the *RELEASE prompt is displayed.

The computer programs necessary to conduct the aerological sounding must now be started.

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PC15

4. Double-click the METGRAPH icon. The Metgraph program will respond by activating the “Sounding Workbench” window. The program must now connect to the system.
5. Select SOUNDING from the main menu then select CONNECT from the sub-menu.
6. Select MW15 PC SERVER as the data source then click **OK**. The program will respond by activating the “Current Sounding” window and a “STATUS:” box at the top of the window will display “EDTMW - CONNECTING”. Once the PC has connected to the MW15, “Status:” will display “EDTMW - WAITING FOR START”. The Metgraph program is now ready to receive data from the system. During the initial power-up of the PC, WinXPPP and WinFILE may have been activated. If these windows are not visible either on the desktop window or on the desktop’s bottom menu bar, the observer must ensure they are activated prior to the release.

NOTE

It is a recommended practice to start WinXPPP before WinFILE.

7. Double-click the WinXPPP icon if not already activated.
8. Double-click the WinFILE icon if not already activated.
9. Contact appropriate authorities (if applicable).

NOTE

If the aerological release occurs in proximity to aircraft traffic, a “call-in” procedure may require that the observer notify ATC, a Flight Services Station or local authorities. Follow the established procedure for your site.

10. The radiosonde is ready to be released.

1.3 In-Flight Procedures

1.3.1. Introduction

In-flight procedures is defined as any duty which must be accomplished after the balloon launch, up to and including the last message transmission. These duties normally take place between the hours of 11:15 and 13:10 UTC for the morning flight or 23:15 to 01:10 UTC for the evening observation.

The main stages of the in-flight routine are :

- (1) Release Data,
- (2) safety precautions,
- (3) data monitoring and calculations,
- (4) message transmissions.

1.3.2. Release Data

Once the release is accomplished, a number of steps must be performed in a timely manner. The observer must promptly secure the inflation building then proceed to observe and record the release data. Release data must be obtained as close as possible to the time of release.

NOTE

Release data observations shall not be made in advance of the release.

1. Observe the dry bulb and wet bulb temperatures, apply the thermometer corrections and record the temperatures in the Release Log.
2. Calculate the dewpoint depression and determine the outdoor relative humidity then record it in the Release Log.

NOTE

This should be close to the outdoor humidity displayed by the MW15 during acclimatization.

- A. When mercury thermometers are used and the outdoor temperature is below -37.4°C , the release humidity shall not be determined as per step 2.
- B. When a Remote Temperature Indicator (RTI or DEWCEL) is used and the outdoor temperature is below -40.0°C , the release humidity shall not be determined as per step 2.

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- C. In either A) or B), the humidity, as displayed by the system during acclimatization, shall be recorded (and input) as the release humidity. The wet bulb and dewpoint depression shall be recorded as missing (**M**).
3. Observe the pressure from the station barometer and record the station pressure in the Release Log.
4. Observe the wind direction to the nearest 10 degrees (2 minute mean) and the wind speed to the nearest 1 knot (2 minute mean). Record these readings values in the Release Log.

Although the radiosonde has been released, the “ascent” is still not underway, with respect to the sounding equipment. As MW15 system time elapses, the system sonde program records PTU values in the “background” and monitors the radiosonde for a decrease in pressure. When the pressure decreases by 5.0 hPa, from the reading obtained during acclimatization (i.e. radiosonde is rising), the program will “go back” to the point in time at which the pressure began to decrease (i.e. surface) and “flag” this time as the “Start”. The MW15 will display a start message.

NOTE

The observer is normally outdoors securing the inflation building or observing temperatures when the start is signaled by the system. After approximately 1 minute, the program will prompt the observer for the “Surface Observation”. The pressure, temperature and humidity values observed and recorded in steps 1, 2 and 3 must now be input respectively, using the MW15 system data entry keypad.

5. Input the pressure to the nearest tenth then press **ENTER**.
6. Input the temperature to the nearest tenth then press **ENTER**.
7. Input the humidity to the nearest whole percent then press **ENTER**. The program will respond with a display of the PTU data as input by the observer in steps 5, 6 and 7.
8. Verify the PTU values displayed are correct. If no errors are found, hit **C4 ACCEPT**. If the PTU values displayed are incorrect, hit **C5 REJECT** and return to step 5.

CAUTION

It is not possible to correct this portion of the surface observation once the PTU values have been accepted. The program will then prompt for the wind direction and speed as observed in step 4.

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9. Input the wind direction to the nearest 10 degrees then hit **ENTER**.
10. Input the wind speed to the nearest 1 knot then press **ENTER**. The program will show a display of the wind data as input by the observer in steps 9 and 10.
11. Verify the wind values displayed are correct. If no errors are found, hit **C4 ACCEPT**. If the wind values displayed are incorrect, press **C5 REJECT** and return to step 8.

CAUTION

It is not possible to correct this portion of the surface observation once the wind values have been accepted.

NOTE

If it is determined that erroneous PTU or wind observations have been input and accepted, a "Second or Subsequent Release" will be required if the error exceeds the following limits :

- | | |
|--------------------|---------------------------|
| (1) Pressure | ± 3.0 hPa |
| (2) Temperature | $\pm 2.0^{\circ}\text{C}$ |
| (3) Humidity | $\pm 20\%$ |
| (4) Wind Direction | $\pm 30^{\circ}$ |
| (5) Wind Speed | ± 5 kts |

If an error in humidity, wind direction or wind speed has been input, a second or subsequent release shall not be required; however, the observer must record the error in the Discrepancy report section of the AMS. When the surface observation has been accepted, the system program will return to monitoring the radiosonde and initiate a transfer of data to the PC.

12. Monitor the Metgraph "Current Sounding" window's "status:" line. The "status:" line in the "Current Sounding" window will display 3 messages in succession.

- **"EDTMW - Saving Station Data"**

The Sonde program will "download" MW15 station parameters and the surface observation to Metgraph. At this point the "METGRAPH" and "TEMP" windows will be activated.

- **“EDTMW - Waiting EDT Data”**

Metgraph is waiting for data from above the surface level. This data will only be displayed in the “Current Sounding” window once two or more levels above the surface are available. This may take several minutes.

- **“EDTMW - Saving EDT”**

Metgraph is receiving and “writing” edited data from the MW15.

NOTE

Because of the amount of “buffering” and processing required, the data displayed by the PC appears to “lag” compared to the MW15 display. This is normal.

1.3.3. Data Monitoring and Calculations

Very little observer intervention is required once the sounding data is being processed and recorded. It is however to the observer’s advantage, to monitor the equipment and recognize, in the early stages of the sounding; malfunctions, missing data, signal loss, “early balloon bursts”, etc. If the sounding terminates before the minimum height criterion is reached, a subsequent release will be required (if time permits).

1. Determine the Release Time (UTC) and record this value in the Release log.
2. Determine the Navaid wind mode (sonde type) and record this information in the Flight log.
3. Record the balloon information in the Flight log.

Although the system is monitoring the radiosonde and PTU values appear to be changing the observer must ensure the sonde program is collecting and editing data in the “background”.

4. Press **DATA** on the OPERATION CONTROL keys. When DATA is selected, a number of options will be displayed :

- **RAW PTU**

So called “raw” PTU data may be obtained as soon as the surface observation is entered. This display is essentially that shown while the system is monitoring the radiosonde.

- **EDT**

“Edited” PTU data from the observation, as calculated by the system sonde program will be displayed. This display is identical to the PTU and WIND data displays on the PC’s “Current Sounding” window.

NOTE

It may take up to 10 minutes before the first EDT results are available for display. If not enough time has elapsed since the release, “Warning, Insufficient Data !” will appear.

- **STD**

This display will show information for the standard levels as in the PC’s “METGRAPH” window, when is selected.

- **WIND**

Wind information is displayed. The data consists of time, wind components described as 2 “vectors” in m/s, wind speed in m/s and the status of the Navaid stations. It may take up to 3 minutes before the first wind information is available for display.

NOTE

When the **HELP** button is depressed on the OPERATION CONTROL keys, after any of the 4 selections above are made, data “headers” will appear on the top line of the display. This will help the observer to identify the parameters displayed by the system sonde program. Any data display listed above, may be “scrolled” by using the ANTENNA/CURSOR keys. If the system is processing data, the display will scroll on its own.

5. Press **C1** RAW-PTU to verify the system is processing “raw” data, then press **DATA** to exit.
6. Press **C2** EDT to verify the system is processing “edited” data, then press **DATA** to exit.
7. Press **C4** WIND to verify the system is processing “wind” data, then press **DATA** to exit.

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8. Hit **DATA** again to return to the monitoring sonde display.
9. Press **TELEM** to monitor the operating frequency and signal strength of the radiosonde.
10. Press **PTU CHANNEL** and Δ **VOLUME** to monitor the audio signal.
11. Monitor **Metgraph** to ensure PTU data are accumulating in the “CURRENT SOUNDING” and “METGRAPH” windows.
12. Click on the button in the “CURRENT SOUNDING” window to “toggle” between PTU and WIND data.
13. Click on the **OR** buttons in the “METGRAPH” window to toggle between PTU and wind plots.

Depending on the speed at which the balloon rises through the atmosphere, shortly before or after “H” (12:00 or 00:00 UTC), the radiosonde will approach the 200 hPa mandatory level . The balloon’s speed will vary over the course of the sounding, therefore the ascent rate is calculated over a large “stratum”. The stratum used is that extending from the surface (H0) to the 200 hPa mandatory level (H200).

NOTE

If the balloon does not reach the 200 hPa level, the ascent rate shall be calculated by substituting the termination level for H200 and substituting the interval of time between release and termination for TIME.

14. Click on the **S** button in the **Metgraph** window and locate the 200 hPa level. Calculate the ascent rate to the nearest whole m/min and record this value in the Flight Log.

1.3.4. Procedures For In-Flight Power Failure

1.3.4.1 Procedures

These instructions are to be followed when performing an aerological observation with the occurrence of a power failure during the ascent. It is recommended that an aerological observation not be performed if the occurrence of the power failure is before the launch of the balloon/instrument package. In these situations the observer should wait until regular power is restored to the equipment before continuing with pre-flight preparations and performing the release. The observer will adhere to and consider time restrictions for late releases before proceeding with pre-flight preparations.

An integral part of the aerological ground equipment package is the Uninterruptible Power Supply (UPS). The specific UPS referred to in this document is the Controlled Power model LT-700. Observers should refer to their specific model of UPS if one other than the LT-700 is being used. Besides conditioning line power the primary function of the UPS is to provide continuous power to the ground equipment. The UPS has been specified to provide up to two hours of continuous power to the ground equipment.

If a power failure occurs after the release of the Radiosonde instrument the observer's responsibility will be to monitor the operation of the UPS. By pressing the **Display Select** button the % Battery remaining can be viewed in the LED display. The % battery indicator is illuminated when this display is selected. The % Battery value will decrease, as the batteries are discharged. A Low Battery indicator will illuminate on the display panel when batteries reach critically low charge levels.

1.3.4.2 Energy Conservation

The 15" SVGA monitor that is part of the PC equipment accounts for approximately 30% of the energy drain on the batteries. The observer can extend the run time of the UPS by switching the monitor off at non-critical times and monitoring the Radiosonde ascent by viewing the displays on the MW15.

1.3.4.3 Low Battery Procedure

If the Low Battery indicator illuminates the observer will immediately take steps to end the ascent, archive the data, and send any bulletins that may be available for transmission. Once these steps have been carried out, the MW15 and the PC shall be shut down. The ground equipment shall not be switched on until the power failure has ended and the UPS is operating on line current.

1.3.5. Message Transmissions

At remote locations where communications systems are occasionally poor, the observer must pay particular attention to message transmissions. Although the first message transmission includes data up to and including the 100 hPa level, **Metgraph** has been programmed to generate the **US UK** and **UG** bulletins once a significant level has been chosen above 65 hPa. This allows for sufficient time to process the data up to 100 hPa. In turn, **WinFILE** will scan the PC hard drive, detect the three bulletins and transfer them to **WinXPPP** for transmission.

1. Verify the **US UK** and **UG** date/time headers and observe the **WinXPPP** window “status” line.
2. Verify **WinXPPP US/UK/UG** transmissions are successful.

At balloon burst the system set will detect an increase in pressure as the radiosonde descends towards the surface. A “**Sounding Stop_Detected**” message will be displayed; however, the loudspeaker will not alert the observer. Once the remaining data has been processed by the system, the display will indicate that the sounding is complete.

3. Verify the system display to ensure the sounding has ended. After the data is processed by the system and transferred to **Metgraph**, the **UL UE** and **UQ** bulletins will be generated in the “**TEMP**” window.
4. Verify the **UL UE** and **UQ** date/time headers and observe the **WinXPPP** window “status” line.
5. Verify **WinXPPP UF/UQ** transmission is successful.

NOTES

- a. If the sounding has not terminated, by H+1:15 the “time trigger” will generate the **UL UE** and **UQ** bulletins for the second transmission. This ensures all 4 aerological bulletins are received by the **MSC** communications network in time for a “deadline” of H+1:20.
- b. Once the system terminates the sounding, a **UL COR**, **UE COR** and **UQ COR** will be generated in the **TEMP** window and transmitted by **WinXPPP** (if bulletins were previously generated by the H+1:15 time trigger). These must be verified as per steps 4 and 5.

- c. If the radiosonde signal is weak or lost due to exceptional range or battery failure, the MW15 system may not detect an increase in pressure and may not terminate the sounding. The equipment may appear to be “hung up”. If this occurs, hit **CMD**. The program will respond with “Do you want_to terminate the sounding”. Press **C4 YES**.

The sounding will end and any bulletins not yet coded will appear in the **TEMP** window once **Metgraph** has received the remainder of the system edited data.

6. Verify the **Metgraph** “Current Sounding” window to ensure the “Status:” line displays “EDTMW - End”.
7. Perform a final check for new bulletins. Select the **WinXPPP** “Options” menu, then select “Send Queued Messages/Check New Bulletins”. The “Log File Display” window will appear and show the bulletins “echoed” back to you, as well as any administrative messages designated for your site.

1.4 Post Flight Procedures

1.4.1. Introduction

Post-flight procedures is defined as any duty which must be performed after the last message transmission, up to including the time the observer departs the aerological facility. These duties normally take place between the times of 13:20 and 14:00 UTC for the morning observation or 01:20 and 02:00 UTC for the evening observation. The main stages of the post- flight routine are :

- (1) Sounding conclusion,
- (2) sounding reports,
- (3) equipment power-down.

1.4.2. Sounding Conclusion

Although “real time” upper air data has been successfully transmitted and “ingested” by the MSC communications network, the observer must ensure a permanent record (archive) of the sounding is created on the PC’s hard drive. As well, a back-up copy must be made on a floppy disk.

CAUTION

It is critical that the post-flight procedures be performed in the order described below. Failure to do so may cause the flight data to be lost by the PC. If this occurs, the observer must power-down the PC, re-establish a connection with the system PC server and “re-run” the whole sounding.

Before proceeding with the “Archive”, the observer must record pertinent data relating to the sounding. This information will be used to complete final entries in the Flight Log, as well as complete the AMS Routine Flight Information report.

1. Obtain the termination pressure and altitude by scrolling to the last level available in the “Current Sounding” window.
2. Record the termination data in the Flight log.
3. Verify all sections in the Ground Check and Release Log as well as the Flight log have been completed then enter your initials.
4. Close the sounding window by clicking on the **CLOSE** button.

NOTE

The “Current Sounding” window will close but the “Sounding Workbench” window will remain open in order to complete the archive.

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5. Select “Archive” on the “Sounding Workbench” main menu then choose “Archive Sounding”.

NOTE

When “Archive Sounding” is chosen, the “TEMP” and “METGRAPH” windows will close. The Metgraph program will respond with the PC hard disk “path” (location) where it intends to write the data.

6. Click on **OK**. Metgraph will respond with “Archive Results”.
7. Ensure “Archiving complete!” is displayed then click on **CLOSE**.
8. Close the “Sounding Workbench” window by selecting “File” and choosing “Exit” on the main menu. At this point the “Sounding Workbench”, “METGRAPH” and “TEMP” windows will close and you will be left with the desktop display.

NOTE

WinFILE and WinXPPP should be left “running” in the event an administrative messages required.

9. Insert the Station Archive diskette in the PC’s 3½” disk drive and double-click the desktop’s “Shortcut to ARCHIVE” icon. Performing this step starts the Windows Explorer (File Manager) and opens the folder (directory) that contains the sounding files. Each sounding is written to its own folder, identified by the Year (YY), Month (MM), Day (DD) and the 1st (.001) or 2nd (.002) flight of the UTC calendar day.

NOTE

For archiving purposes, the flight is considered to be performed using UTC time. E.g. the September 22/0000 UTC sounding will be released on the 21st at 23:15 UTC therefore it will be written to a folder labeled 000922.001.

CAUTION

The Windows operating system, Metgraph or other programs may become corrupted or inoperative if the observer deviates from the instructions below.

10. Locate the folder that corresponds to the sounding archived and highlight it by “single-clicking” the left mouse button. The sounding file will appear in the right half of the Windows Explorer window. The first six digits of the filename will correspond to the year (YY), month (MM) and day (DD) on which the release was performed. The last character of the “filename” will be a lower cased “e” (e.g. 00092111.15e).
11. Move the mouse over the top of the filename and right click then select “Send To” then “3½ Floppy (A)”. At this point, the floppy disk drive light will come ON to indicate the flight file is being written to diskette. The observer must verify the diskette contains the flight file for the sounding. A small window at the top of the Explorer program contains a menu among the “drop down” menus which allows the observer to select another folder.
12. Select this menu by clicking over it in the “drop down” menu. The contents of the diskette will appear in the right window of the explorer program. Verify the flight has been archived.
13. Close the “Shortcut to ARCHIVE” (Windows Explorer) and remove the diskette from the floppy drive.

1.4.3. Sounding Reports

A descriptive summary of the sounding must now be completed using the AMS (Aerology Monitoring System) and WinIFF. This information will consist of several reports, depending on the particulars of the sounding :

(1) Routine Flight Information Report

This report is mandatory for all aerological releases attempted.

(2) Discrepancy Report

A discrepancy report must accompany the Routine Flight Information report if the sounding is unsuccessful or equipment faults are observed during a sounding.

(3) Balloon Rejection on Ground Inspection Report

This report must be completed if a balloon defect was observed before, during or after inflation and the balloon was not used for the sounding.

(4) Radiosonde Rejection on Ground Inspection Report

This report must be completed if a radiosonde defect was observed prior to the release and the instrument was not used for the sounding.

(5) Administrative Message Report

An administrative message must be completed and transmitted if there is an occurrence of :

- a. Delayed bulletins,
- b. delayed release,
- c. second or subsequent release,
- d. unsuccessful flight.

1.4.4. Equipment Power Down

The observer must ensure that all log entries, AMS reports and administrative messages have been completed prior to powering down the equipment.

CAUTION

Once the system set is powered down, the flight data will be lost permanently.

1. Power-down the PC by using the Windows '95 Start menu and selecting "Shut Down...".

NOTE

Depending on the Windows "settings", the PC will either power-down automatically or prompt the observer to wait. If the latter is the case, after a few minutes the observer will receive a message indicating "It is now safe to shut down your computer". The PC may then be powered-down using the power push button.

2. Place the system rawinsonde set in stand-by mode. Using the MW15 system control keys, press and hold the **ENABLE** key and depress the **STBY OFF** key. The Stand-by "amber" light will go ON.
3. Dispose of used materials (such as calibration tape) to avoid confusion or errors during subsequent soundings.
4. Ensure a neat and organized work station.
5. Ensure the archive diskette is properly stored and all Logs are in order.

CHAPTER 2

DELAYED MULTIPLE OR UNSUCCESSFUL RELEASES

2.1 Criteria

An ascent is considered successful if acceptable data are obtained up to and including the 400 hPa Level. If a first attempt is unsuccessful, a second attempt shall be made up until H + 1:45 (i.e. no release shall be attempted after 01:45 UTC or 13:45 UTC).

1. A second release shall be attempted if the system rawinsonde set terminates the sounding due to missing pressure or temperature data below the 400 hPa level.
2. Second release attempts shall not “normally” be made due to missing Humidity or Wind data. In such cases, a Regional Support Desk or Forecast Office must be contacted for further instructions. These instructions may include a request for another sounding.

2.2 Release Times

Every effort shall be made to perform the release at precisely the Official Time of Observation (i.e. H-45 minutes). Deviations from the official times are not permitted without approval from National Headquarters. Because conditions beyond the control of the observer may cause short delays in performing the release, actual release times between H-45 and H-31 shall be considered “normal”. Radiosonde releases shall not be made in advance of H-45 or after H+1:45.

| Observation | Normal | Delayed |
|-------------|----------------------|----------------------|
| 2315 UTC | (23:15 to 23:29 UTC) | (23:30 to 01:45 UTC) |
| 1115 UTC | (11:15 to 11:29 UTC) | (11:30 to 13:45 UTC) |

2.3 Message Transmissions (First Release)

Upon determining that an aerological ascent is not successful, the system will terminate the sounding. In some instances such as a weak or loss of signal, the observer must “Stop” the sounding manually. Once the sounding has terminated, all remaining data in the system will be processed and transferred to the “Metgraph” program. The “Current Sounding” window will then display “End” and the US, UK, UG, UL, UE and UQ bulletins will be generated in the “TEMP” window as well as written to the PC hard drive.

The US/ UK and UG bulletins normally contain data up to the 100 hPa level, therefore these bulletins will appear smaller or shorter than normal. The UL/UE and UQ bulletins normally contain data above the 100 hPa level to termination, therefore they will comprise only the “header”, one line of coded data, followed by the word “NIL”.

“WinFILE” will then scan the computer’s hard drive for the bulletins and move them to “WinXPPP” for transmission. This operation is performed within the span of a few seconds. To confirm the transmission of the upper air data; go to the “WinXPPP” window, select the “Display” menu and choose “Display Log Messages”. There will be 3 options at this point :

- (1) Sent & Received.
- (2) Received Only,
- (3) Sent Only.

Select “Sent & Received”. A “Log File” window will appear confirming the modem connection and message transmission as well as any messages received (echoed).

2.4 Ending the Sounding (First Release)

Once you have confirmed your message transmission, there are several steps to complete prior to attempting a second release :

1. Close the “Current Sounding” window;
2. archive the sounding (hard drive);
3. close the “Sounding Workbench” window;
4. complete an AMS Routine Flight Information report;
5. complete an AMS Discrepancy report;
6. power down the computer;
7. power down the system rawinsonde set.

Closing "Sounding Workbench" and the system shut-down are performed as per section 1.4.4 . The AMS entries are completed as per section 3. A successful sounding is normally archived on the computer’s hard drive and a 3 ½” diskette. In the case of an unsuccessful sounding, do not copy to a 3 ½” diskette until :

- (1) It is determined that no second release will be attempted.
- (2) A second or subsequent sounding is successful.
- (3) If all attempts are unsuccessful, the greatest altitude attained will be designated as the official observation and then copied to a diskette.

NOTE

An administrative message is not filed at this time, unless it is decided that a subsequent release will not be attempted.

2.5 Second Release Procedures

The first step in preparing a second or subsequent release is to proceed with the equipment power up and the pre-flight routine as per established procedures. Having recorded the operating frequency of the radiosonde in the Ground Check and Release Log, you must adjust the new radiosonde's operating frequency such that :

- (1) It does not conflict with the previous radiosonde signal;
- (2) it is still within its optimum operating range (401 to 403 MHz band).

Once the instrument has been tuned, verify the system PTU audio and telemetry signal strength to ensure the signal is "clean" and strong prior to performing a ground check.

NOTE

2.0 MHz detuning from the previous radiosonde should suffice.

Proceed with the pre-flight routine that has been established for your station, then release.

2.6 Message Transmissions (Second Release)

The transmission of upper air data from a second release will differ slightly from routine message transmissions. (Note that the US, UK, UG, UL, UE and UQ bulletins were transmitted from the unsuccessful ascent and have been ingested by Meteorological Service of Canada's communication system).

1. If the second sounding is successful,
2. or the second sounding reaches an altitude greater than that of the previous attempt and time restrictions do not permit another release,
3. then the new data must be made available to the user in the form of corrected bulletins (COR's).

During a normal sounding, bulletins are coded in the "TEMP" window, scanned by "WinFILE" and moved to "WinXPPP" for transmission. The observer has little or no control over this operation. Since corrected bulletins must be transmitted from a successful (or higher) attempt, the observer must temporarily disable (close) the communications software in order to edit the bulletins as COR's, prior to transmission.

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As soon as the sounding is under way and data is being processed in the “Current Sounding” window, close “WinFILE”. This will prevent the transfer of upper air bulletins to WinXPPP. Closing WinFile can be done in a number of ways :

- (1) Click the “X” at the top right corner of the window;
- (2) select “File” from the menu and choose “Exit”;
- (3) click the icon at the top left corner of the window and select “Close”.

Aerological bulletins can be generated in 3 ways :

- (1) “Manually” : Highlight the desired header and click the “**CODE**” button;
- (2) “Pressure Trigger” : 65 hPa (US, UK UG) and TRM (UL, UE UQ).
- (3) “Time Trigger” : H+1:15 (US, UK, UG, UL UE, UQ). This allows 5 minutes to transmit the bulletins before the H+1:20 deadline.

If the second or subsequent release occurs prior to the H+1:15 “Time Trigger”, the US, UK, UG, UL, UE UQ bulletins will be generated at H+1:15 during the subsequent sounding, regardless of the altitude attained. These messages will contain little or no data , depending on the time the subsequent release took place.

Since all 6 bulletins were transmitted from the first sounding, the message deadline of H+1:20 does not apply to the subsequent sounding. If the bulletins are generated by the “Time Trigger”, they must be ignored (closed). The “Bulletin windows” (US, UK, UG, UL, and UE UQ) can be closed in one of two ways :

- (1) Click the “X” at the top right corner of the message window;
- (2) click the icon at the top left corner of the message window and select “Close”.

2.6.1. Example

A second release has only reached the 850 hPa level when the H+1:15 time trigger generated all 6 bulletins. These bulletins must be closed. The observer must wait for the 65 hPa pressure trigger to generate the US, UK and UG bulletins, since the H+1:20 message deadline has already been met. When a significant level is selected above 65 hPa the US, UK and UG bulletins (containing data to 100 hPa) will be generated. They must then be edited and transmitted as COR’s.

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Proceed to the “TEMP” window and place the cursor in the “US.txt” window after the date/time group of the message header. This is accomplished by placing the mouse over the header and left-clicking once. You will then see a cursor “blinking” in the message header. Using your cursor keys, move the cursor to the end of the date/time group and insert one blank with your space bar. Following this, in UPPER CASE, type in the letters **COR**.

Now that you have edited the US bulletin header, you must save your changes to the computer’s hard drive. To save your changes, left-click the “File” menu in the top left corner of the “Temp” window and choose “Save”.

If the top bar of the “US” window is highlighted, your changes will be saved. You have now edited the US bulletin, identified it as a correction and saved the changes to the hard drive of the computer. Minimize the “US” window by left-clicking the minus sign at the top right corner. Repeat the process with the UK and UG window.

Once the bulletins have been edited and the changes have been saved, enable (open) the communications software to transmit the bulletins :

- (1) Open WinFILE using the WinFILE Icon.
- (2) Another method of opening “WinFILE” is to click on the Microsoft Windows “Start” button and select :
 1. Programs
 2. WinIDE
 3. Winfile

When “WinFILE” has been enabled, it will scan the computers hard drive and move the edited US/UK and UG bulletins to “WinXPPP” for transmission. The US COR, UK COR and UG COR will now replace the data from the previous sounding and be available to the user in the communications system.

NOTE

If the H+1:15 time trigger has previously generated all 6 bulletins, WinXPPP will also transmit the UL NIL UE NIL and UQ NIL along with the edited US COR UK COR and UG COR. The UL, UE and UQ contain no data (NIL), therefore will not affect the communications system.

The computer’s communications software must be disabled again, so that the UL, UE and UQ as COR’s when they are generated at termination.

2.7 Ending the Sounding (Subsequent Release)

Once the message transmissions from the successful or highest ascent have been confirmed, proceed with the normal post-flight routine established for the station :

1. Close the “Current Sounding” window;
2. archive the sounding (hard drive);
3. close the “Sounding Workbench” window;
4. archive the sounding (3 ½” diskette);
5. complete an AMS Routine Flight Information report;
6. complete AMS Discrepancy report (if unsuccessful);
7. generate an administration message if required;
8. power down the PC;
9. power down the system rawinsonde set.

Closing the Sounding Workbench and system power-down are performed as per normal procedures.

CHAPTER 3

QUALITY CONTROL AND DISPOSITION OF RECORDS

3.1 Aerology Monitoring System

3.1.1 Introduction

The AMS (Aerology Monitoring System) is a Windows based computer program used for recording and processing aerological information. Several short and long term benefits are achieved by using AMS :

- Streamlined paper flow of aerological reporting details.
- Reduced input errors.
- More timely and accurate information.
- Improved analysis capability.

There are three levels of access within AMS. Each access level can navigate through the system but some menu choices will be "shaded". This means access to a particular feature of AMS is limited. In other cases, a message will appear stating that the function you requested is not available to you. The access levels are as follows :

- (1) Aerological stations.
- (2) Regional offices.
- (3) National headquarters.

At the upper air station level you will be required to complete 4 types of reports and perform record keeping duties. These tasks include :

- (1) The Routine Flight Information report.
- (2) The Discrepancy report.
- (3) The Balloon Rejection on Ground Inspection report.
- (4) The Radiosonde Rejection on Ground Inspection report.
- (5) Packing and Re-indexing files.
- (6) Creating AMS Data diskettes.
- (7) Receiving tables.

3.1.2 Main Menu

There are five "pull down" or "drop down" menus located at the top of the AMS window.

3.1.3 Flight Menu

The "Flight" menu allows viewing or access to different lists of reports that are filed in the AMS database of the PC. This menu also enables exiting of the AMS program.

- Flight Information
Record or edit a Routine Flight Information report (and any associated discrepancies).
- View Discrepancies
View a list of recorded Discrepancy reports.
- Balloon Rejection Ground
Record or edit Balloon Rejection reports.
- Sonde Rejection Ground
Record or edit Sonde Rejection reports.
- Exit
Exit the AMS program.

3.1.3.1 Flight Information Report

A Flight Information report must be completed for each aerological sounding performed, if it is successful or not.

To record a Routine Flight Information report, select the "Flight" menu and choose "Flight Information". The "Flight Information" window appears and shows the reports entered in the AMS database, from most recent to oldest. At this point there are three options :

(1) Delete an existing report

Deleting an existing report is executed by first highlighting the report on the list and using the option "Delete" in the "Commands" menu.

(2) Edit an existing report

Editing an existing report is accomplished by first highlighting the report on the list, then selecting it (right-click). The "Flight" window appears allowing you to then change the applicable field(s) and/or add a Discrepancy report. Click on the "**EXIT**" button. Your changes (and/or discrepancy) will be saved.

(3) Insert a new report

To record a Routine Flight Information report, choose "Insert" in the "Commands" menu. The "Flight " window will appear with several fields completed. The Station Name, Region and Call Sign cannot be altered. The year, month and day will "default" to the computer's settings. Once the year, month and day have been verified, use the mouse to insert a "bullet" in the circle provided to identify the UTC standard hour of the aerological sounding. The remaining fields are completed as follows :

- A. Balloon Manufacture : Date Year and Month.
- B. Release : First, Second.
- C. Successful Flight :YES or NO. Note that at least one Discrepancy report must be entered if "NO" is selected.
- D. Radiosonde Serial Number :From the calibration tape or Radiosonde case.
- E. Nozzle Lift : grams (nearest 25)
- F. Ascent Rate : m/min (nearest whole)
- G. Termination Pressure : hPa (nearest tenth)
- H. Termination Altitude : gpm (nearest whole)
- I. Flight Remarks : Enter information pertinent to the aerological sounding. e.g. "**see discrepancy report**".

Once all the fields in the Routine Flight Information report have been completed, three options are available :

- **Discrepancy Report**
Button that presents you with a list of the Discrepancy reports in the AMS database.
- **Cancel**
Button that exits the Flight window and does not record your report in the AMS database.
- **Exit**
Button that exits the Flight window and records your report in the AMS database.

A Routine Flight Information report, as well as a Discrepancy report, must also be recorded if :

(1) The radiosonde or balloon is damaged at release, such that data are not available above the surface level. The following fields of the Routine Flight Information report should be completed as described below, prior to recording the Discrepancy report.

- Successful Flight **"NO"**
- Ascent Rate **"0"**
- Termination Pressure **"Station Pressure"**
- Termination Altitude **"Station Elevation"**
- Remarks **"Unsuccessful due...."**

(2) The sounding does not attain the 400 hPa level. The following fields of the Routine Flight Information report should be completed as described below, prior to recording the Discrepancy report.

- Successful Flight **"NO"**
- Ascent Rate **"Calculate from Sfc to Trm"**
- Termination Pressure **"Trm Pressure"**
- Termination Altitude **"Trm Altitude"**
- Remarks **"Unsuccessful due...."**

3.1.3.2 Discrepancy Report

If faults or discrepancies are observed during an aerological sounding, with any of the components or equipment related to the sounding, a Discrepancy report must be recorded. This includes, but is not limited to; the radiosondes, balloons, computers, software, system, antenna, communications.

NOTE

Radiosonde or balloon defects observed prior to the release, are recorded as "Rejection" reports elsewhere the AMS database.

A Discrepancy report is created by following the steps below :

1. To record a Discrepancy report, click on the "**Discrepancy Report**" button located at the bottom right corner of the "Flight" window. A list of the Discrepancy reports contained in the AMS database will appear. Go to the "Commands" menu and select "Insert". A "Discrepancy" window will appear. The first 5 fields are entered by the AMS program (from the Routine Flight Information report) and cannot be modified.
2. The "Down Time" field refers to the number of hours you were unable to produce or communicate aerological data. It is normally left at "0" unless the upper air bulletins are "delayed".
3. To complete the remaining fields, choose the letter code that best describes the event and use the "Remarks" section to clarify (e.g. "**Back-up computer used**"). Once the entries are completed, click on the "**Exit**" button to record your report in the AMS database.
4. Deleting an existing report is executed by using the option "**Delete**" in the "Commands" menu. Editing an existing report is accomplished by first highlighting the report to be edited and selecting it. Changes are made to the applicable field(s). Click "**EXIT**" to save the changes.

3.1.3.3 Balloon Rejection Report

If balloon defects are discovered prior to or during the inflation and the balloon is not utilized for the sounding then a Balloon Rejection on Ground Inspection report must be completed.

A. Creating Balloon Rejection Reports

1. To record a Balloon Rejection report, select the "Flight" menu and choose "Balloon Rejection Ground". The "Balloon Rejection Ground" window will appear listing the reports entered in the AMS database. Proceed with the "Commands" menu and select "Insert". A "Balloon Rejection on Ground" window will appear. The first 3 fields are completed and cannot be modified. The year, month and day will default to your computer's settings.
2. To complete the remaining fields, choose the letter code that best describes the event and use the "Remarks" section to clarify. Once the entries have been completed, click on the "**Exit**" button to record the report in the AMS database.

B. Additional Information

1. Deleting an existing report is executed by using the option "Delete" in the "Commands" menu.
2. Editing an existing report is accomplished by first highlighting the report you wish to edit and selecting it. Changes can be made to the applicable field(s). Click on the "EXIT" button and the changes will be saved.

NOTE

If a case or particular lot of balloons are rejected due to defects or damage, then a Balloon Rejection report should be completed.

3. In the event that a Rejection report needs to be completed for a date other than "today" :
 - a. Change the year, month, day on your computer's clock to the desired setting;
 - b. start the AMS program;
 - c. record your Rejection Report;
 - d. exit the AMS program;
 - e. set the computer's clock back to the correct year, month, and day.

3.1.3.4 Sonde Rejection Report

If radiosonde defects are discovered prior to or during the ground check and the radiosonde is not utilized for the sounding, then a Sonde Rejection on Ground Inspection report must be completed.

A. Creating a Sonde Rejection Report

1. To record a Sonde Rejection Report, select the "Flight" menu and choose "Sonde Rejection Ground". The "Sonde Rejection Ground" window will appear listing the reports entered in the AMS database. Proceed with the "Commands" menu and select "Insert". A "Sonde Rejection on Ground" window will appear. The first 3 fields are completed and cannot be modified. The year, month and day will default to the computer's settings.
2. To complete the remaining fields, choose the letter code that best describes the event and use the "Remarks" section to clarify. Once entries have been completed, click on the "Exit" button to record your report in the AMS database.

B. Additional Information

1. Deleting an existing report is executed by using the option "Delete" in the "Commands" menu.
2. Editing an existing report is accomplished by first highlighting the report you wish to edit and selecting it. Changes can be made to the applicable field(s). Click on the "EXIT" button and the changes will be saved.

NOTE

If a case or particular lot of radiosondes are rejected due to defects or damage, then an Radiosonde Rejection Report should be completed.

3. In the event that a Rejection Report needs to be completed for a date other than "today":
 - a. Change the year, month, day on your computer's clock to the desired setting;
 - b. start the AMS program;
 - c. record your Rejection Report;
 - d. exit the AMS program;
 - e. set the computer's clock back to the correct year, month, and day.

3.1.3.5 Utilities Menu

The "Utilities" menu allows you to perform various maintenance functions associated with the AMS database files on your computer.

- Pack/Reindex

Performs a file clean-up and tuning of the AMS database. This includes deleting all files older than 12 months.

NOTE

It is recommended that this function be performed weekly.

- Send Data

Copies all AMS records for the month onto diskettes or e-mails a copy of flight data

- Receive Tables
Copies information from a diskette to the CODE TABLES stored in your AMS program.
- Set Up
Allows basic information to be updated
- Inventory
Maintains inventory of aerological consumables

A. **Pack/Reindex**

The "Pack/Reindex" utility performs a file clean-up and tuning of the AMS database. This function includes deleting all files older than 12 months. This task is also the first step to creating AMS diskettes.

1. To pack and re-index your AMS database, select the "Utilities" menu and choose "Pack/Reindex". The "Pack/Reindex" window will appear prompting to confirm this function.
2. Proceed by clicking "**Yes**". A few seconds will elapse and the AMS program will confirm that the operation is complete.

B. **Send Data**

This selection is only available to aerological stations. The utility will create either a diskette or e-mail a copy of flight recordings, radiosonde rejections, and balloon rejections to MSC National and Regional offices for review.

1. AMS will prompt for a formatted diskette and will create the necessary files and download onto the diskette. New observations and rejections for the month will be stored as well as changes and deletions since the last update.
2. Resending of the data is possible by clicking on the **Resend** button and filling in the date range of records to be resent. The date range is based on the date the data was entered into the site PC.
3. In order to e-mail the monthly observations, proper configuration of the e-mail settings is required. Each individual site is configured to meet requirements based upon regional and national requirements.

C. Receive Tables

The "Receive Tables" utility performs an update of the AMS program's letter codes and descriptions. Upper air stations will periodically receive diskettes from their Regional Office or National Headquarters, which contain updated tables. The tables must be copied to the AMS program on the hard drive of the computer.

1. To copy the tables from a 3½" diskette to the computer's hard drive, select the "Utilities" menu and choose "Receive Tables". The "Receive New Tables" window will appear. Verify that the AMS Program will copy the new information from the 3½" diskette to the computer's hard drive. A "bullet" will be displayed beside the "A:". Place the diskette containing the new tables into the computer's 3½" floppy drive and click on "**Continue**".
2. A small window at the top right corner of the screen will display messages indicating the tasks being performed by the computer during the installation. Once the information on the diskette has been copied a "Receive Tables" window will appear confirming the installation.
3. Click on "**OK**" to return to the main menu bar and exit AMS.

D. Set Up

This utility allows basic setup information to be updated. In most cases this aspect is performed by regional inspectors during site visits.

E. Inventory

This utility allows for inventory display and maintenance of aerological consumables. It is divided into 4 subsections : Listing, receipts, adjustments and stock taking.

a. Listing

Allows a Read Only view of aerological consumables inventory levels

b. Receipts

Upon receiving additional inventory, sites will be required to update the values reflected on inventory for specific items as per the procedures below .

1. Click on **Utilities**;
2. select **Receipts**;
3. highlight in the **ADD NOW** column the item to be updated;
4. press **ESC** and AMS will provide a prompt window to reset the stock quantity;
5. After the entry has been made, press **Enter**;
6. AMS prompts to accept the amended value. Click on **YES**;
7. Confirm the action has been completed by selecting **Utilities** then **Listing** to view the data;
8. Press **ESC** to exit the screen.

c. Adjustments

At times the site may be required to make corrections to the value of stock on hand. This utility allows this to take place as per the following procedures :

1. Select **Utilities** then **Inventory** then **Adjustments**
2. In the **Reduce** column enter a negative value to increase the value and a positive value to decrease the value of stock on hand.
3. Press **ESC** to exit the screen

d. Stock Taking

On the upgrade of AMS at each site, a starting balance of inventory of each item is required. This will allow the automatic updating of totals to be completed after each ascent by AMS. To proceed, follow :

1. Select Utilities then Inventory then Stock Taking;
2. highlight the item to be amended;
3. right click the cell in the Item column
4. AMS will prompt for a revised value
5. after the revised value has been entered AMS will prompt to accept the new value;
6. click on **YES**;
7. the new value entered will be reflected in the Start and Balance columns;
8. Press **ESC** to close window

3.1.3.6 Commands Menu

The "Commands" menu provides shortcuts to navigate through the AMS report list you have selected. This menu also enables you to record or delete a report of the same type. These features are convenient when maintaining a large AMS database.

- Top
Takes you to the top of the list of reports you have selected from the Flight menu.
- Bottom
Takes you to the bottom of the list of the reports you have selected from the Flight menu.
- Next
Takes you to the next report on the list.
- Previous
Takes you to the previous report on the list.

- Insert
Enables you to insert or input a new report in the AMS database.
- Delete
Enables you to erase a report from the AMS database.

NOTE

If you use this option to delete a Routine Flight Information report, all Discrepancy reports associated with this record will also be deleted.

3.1.3.7 Help Menu

The "Help" menu allows access to the User's Guide for the Aerology Monitoring System WIN95/V 2002 "on line".

3.2 Archive Data

3.2.1 Introduction

The purpose of archive diskettes is to provide short term storage of each aerological flight data over a calendar month. The data shall be archived onto two diskettes labeled Main and Station.

3.2.2 Monthly Archiving Requirements

The flight data contained on any archive diskette shall not span more than one calendar month (data covering a part of two different months shall not appear on the same diskette). A new diskette shall be put into use commencing with the first observation (normally 0000 UTC) of each month.

3.2.3 Labelling of Diskettes

The archive diskettes are to be labelled as follows :

**MAIN ARCHIVE
KELOWNA B.C. 71203
0302010000 - 0302281200**

**STATION ARCHIVE
KELOWNA B.C. 71203
0302010000 - 0302281200**

3.2.4 Mailing of Diskettes

After the final observation of the month has been completed the Main Archive diskette(s) shall be mailed to **Meteorological Service of Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4 Attn: NADM**. An envelope or mailer shall be used to provide sufficient protection during transit. Any comments relating to the archived data on the diskettes shall be placed in the mailer with the diskettes.

APPENDIX A

EQUIPMENT & SOFTWARE

1. EQUIPMENT

The aerological equipment consists of 4 main components :

- Antennae,
- rawinsonde set (DigiCORA MW15),
- personal computer and peripherals,
- UPS (Uninterruptible Power System).

A) Antennae

Aerological antennae are essential for receiving Navaid as well as radiosonde signals. The antennae are normally installed on the roof of the aerological building or at an elevated point on the grounds of the facility. Three antennae are connected to the DigiCORA MW15 Rawinsonde Set (Fig. A1) :

1) UHF Telemetry Antenna

This antenna consists of six elements housed within a water tight round shaped dome (radome). Only a single element interacts with the MW15 at any given time. Element selection is made from one of six horizontal directions (N, NE, SE, S, SW or NW). Antenna control is automatic or manual through the DigiCORA MW15. The UHF telemetry antenna has no moving parts.

2) GPS Antenna

Like the UHF antenna, the GPS antenna has no moving parts. It consists of a single element, a filter and an amplifier housed within a small plastic radome. The radome is usually mounted on a 1.5 metre pole.

3) Local VLF & Loran-C Antenna

This antenna is of steel and glass fibre construction. It is a free standing “whip” antenna which monitors local reception of VLF or Loran-C signals. Note that VLF and Loran-C wind finding methods cannot be used simultaneously.

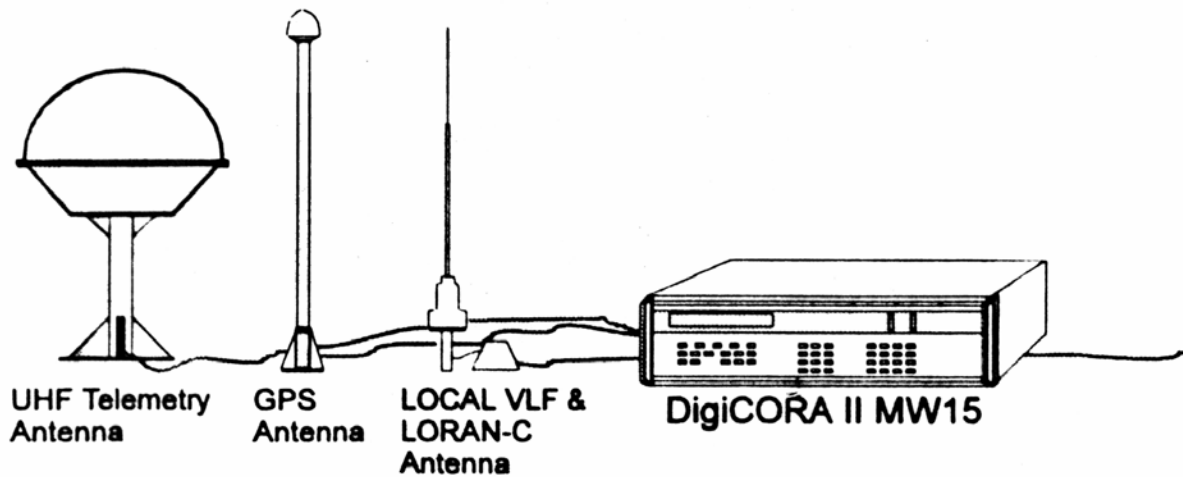


Figure A1 Antennae

B) Rawinsonde Set (DigiCORA MW15)

The Rawinsonde Set or DigiCORA MW15 can be divided into 3 modules :

1) Power Supply

The MW15 can operate on 115/230 VAC or 11...33 VDC power sources. An internal battery is capable of supplying back-up power for up to 2 minutes.

2) Radio Reception

When the MW15 receives the radiosonde signal, it automatically tracks the radiosonde's frequency and controls the UHF Telemetry Antenna. Signals can be monitored by the observer using a built-in loudspeaker or LCD display.

3) Signal Processing

The MW15 processes the incoming radiosonde signal into "raw" PTU data using a receiver-processor unit. The data is then sent to the main processor for final computation before being output to the PC.

The front panel keys control virtually every facet of the MW15's operation. There are 5 main features on the front panel :

a) SYSTEM CONTROL KEYS

These push buttons turn the MW15 to ON, OFF, STAND-BY or RESET.

b) DISPLAY

The MW15 is equipped with a Liquid Crystal Display (LCD) which is capable of showing two lines of 40 characters each. As well, two Light Emitting Diodes (LED) indicate the status of the MW15 (ON or STAND-BY).

c) OPERATION CONTROL KEYS

These are menu driven keys which give commands to the MW15 such as : show information, execute a task, adjust the LCD display or adjust the radiosonde signal volume.

d) ANTENNA / CURSOR KEYS

These keys enable the observer to alter azimuth and elevation angles of the UHF Telemetry Antenna as well as scroll data in the LCD display window.

e) DATA ENTRY KEYS

These are numeric keys which enable the observer to input different parameters such as date and time. Radiosonde parameters (e.g. calibration coefficients) are normally entered using the TAPE ENTRY slot but may be entered using the DATA ENTRY keys if necessary.

C) Personal Computer and Peripherals**1) Personal Computer**

This “interface” serves 4 functions :

- a. Provides a numerical and graphical display of the radiosonde data received and processed by the DigiCORA MW15;
- b. enables the observer to edit bulletins and construct messages;
- c. interacts with the M.S.C. communications network to transmit as well as receive aerological and administrative bulletins;
- d. allows for archiving of aerological data and input of flight reports.

2) Monitor, Keyboard and Mouse

These peripherals are standard features of most modern day PC's. These tools provide the observer with the ability to see and input data as well as navigate through the software environments necessary to complete an aerological sounding.

3) Printer

Although the DigiCORA MW15 may provide direct printer output, a printer is normally connected to the PC. If needed, the printer can supply a hardcopy of aerological bulletins, administrative messages or some MW15 information, such as system settings.

4) Modem

The modem is the interface between the PC and MSC communications network.

D) UPS (Uninterruptible Power System)

A UPS or Uninterruptible Power System has been incorporated into the upper air equipment. The UPS serves 3 functions :

- 1) Converts local power into regulated computer-grade power;
- 2) monitors the "quality" of power it receives and detects anomalies or outages;
- 3) Provides battery power during local power outages.

The UPS allows the observer to complete the aerological sounding in the event of a local power failure. It will "take over" the function of supplying power to the aerological equipment when necessary. The UPS normally consists of the following main components :

4) Battery

The battery is either internal or external. It is usually replenished during normal operation by a small charger and becomes the power source for the aerological equipment when the UPS is activated.

5) Inverter

Takes DC power from the batteries and converts it to AC power when necessary.

6) Transformer

Conditions “raw” AC power to computer grade AC.

7) Microprocessor

Monitors line power quality and UPS status.

1. SOFTWARE

The operating system used on the aerological PC is Microsoft Windows '95. Within this environment, 3 other software packages are required to complete the aerological sounding, transmit bulletins and send or receive messages :

- Metgraph,
- WinIDE,
- AMS.

A) METGRAPH

The function of the Metgraph software program is to transfer the aerological data from the MW15 set to the PC. It provides an alphanumeric and graphical display of the sounding information as well as some editing capabilities. Archiving of flight data on the PC's hard drive is also accomplished by Metgraph. Like most Windows software, the program is started by double-clicking on the Metgraph icon.

Through Metgraph, the PC becomes the active part of the conversation between the observer and the DigiCORA MW15. Although this communication is somewhat limited, it is expected to play an increasing role in controlling the MW15 Set as software development progresses. Metgraph consists of 6 Windows applications, some of which are essential and others optional :

1) Sounding Workbench

The Sounding Workbench window is essential to the sounding as it establishes a connection between the PC and the MW15. This allows the PC to request data from the MW15, interpret it and write it to specific files on the PC hard drive.

2) Sounding Window

The Current Sounding window is a simple alphanumeric display window. It shows edited data from the sounding in progress at 10 second intervals and operates “within” the Sounding Workbench window.

3) Metgraph Window

The METGRAPH window is a graphical window which displays a plot of the edited data from the MW15. The data is typically that of the sounding in progress (i.e. current sounding) but may be used to open and view previous flight data which has been written to the PC's hard drive (or diskette).

4) Temp Window

The TEMP window is an aerological bulletin coding utility. It may be used any time during the sounding and like the METGRAPH window it also has the capability to open previous flight data which has been archived.

There are several other features in the TEMP window. Station Information, Date and Time of the aerological release and the current radiosonde position (time, height and pressure) may be obtained in the TEMP window.

5) Climate Window

The CLIMAT window is used to process data needed for a CLIMAT TEMP bulletin and to compile monthly statistics for mandatory pressure levels.

6) SPC Data Handler Window

The SPECIAL (SPC) DATA HANDLER window is a program designed to be used with special data such as ozone, radioactivity, etc. The SPC data handler will calculate values, perform quality analysis and write special sensor data to the PC hard drive.

B) WINIDE

The Windows Interactive Data Entry program or WinIDE, is a collection of several different functions whose main purpose is to prepare, transmit and receive messages. There are 3 WinIDE windows associated with the aerological version of this program :

1) Winfile

As we know, the aerological bulletins are generated in the TEMP window and written to a predetermined directory on the PC's hard drive. When activated, the Aerology WinFILE program scans this directory at regular intervals. If an aerological bulletin is identified, it is transmitted to the M.S.C. communications network via WinXPPP.

2) WinXPPP

The WinXPPP program is a 32 bit communications application specifically designed to operate for aerology using the Windows 95 environment. Its function is to transmit messages that have been input from WinFILE (or WinIFF) as well as receive messages from the MSC communications network.

3) WinIFF

The WinIFF program is used to construct “Free Form” bulletins (administrative messages) regarding flight performance.

C) AMS

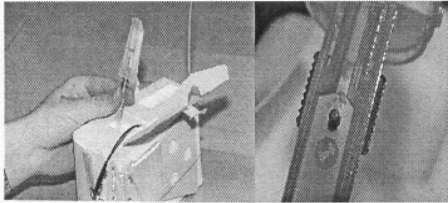
The AMS (Aerology Monitoring System) is also a Windows based computer program. It is used to record and process information from the aerological sounding such as; the type of equipment used, the altitude attained, equipment failures, etc.

APPENDIX B

REMOVAL OF CONTAMINATION SHIELDS

To protect the temperature and humidity sensors on Vaisala RS80 radiosondes against contamination during storage, as well as against possible mechanical damages during transportation or other handling, a new type of protective shield has been added onto the sensor boom. For more detailed information, see User's Guides RS80-U024en-1.3 and RS80-U164en-1.6; and Information Release R637en 2000-05.

Before using the radiosonde, remove the protective shield as follows:



Figures 1a & 1b

Open the flap on the side of the radiosonde and take a firm grip of the plastic holder on the lower part of the sensor boom.

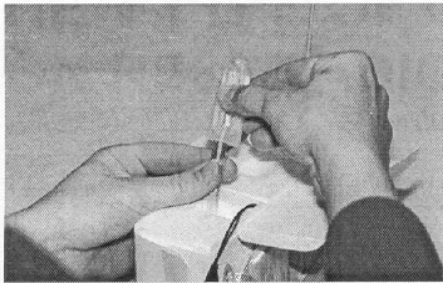


Figure 2

With your other hand, take a firm grip of the protective shield. At the same time, keep the thumb and index finger of your left hand on the plastic holder so that the small peg of the holder remains in the hole of the sensor boom (see also Fig. 1b). Prepare to remove the contamination shield carefully with your right hand as shown in Fig. 3.

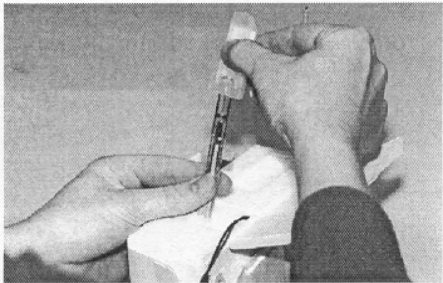


Figure 3

Remove the shield cap by gently sliding it off the sensor boom (directly upwards)

NOTE: Do not remove the small silver cap on the humidity sensor. It protects the humidity sensor from rain and solar radiation. In case the cap drops off, re-install it with clean fingers, preferably with tweezers.

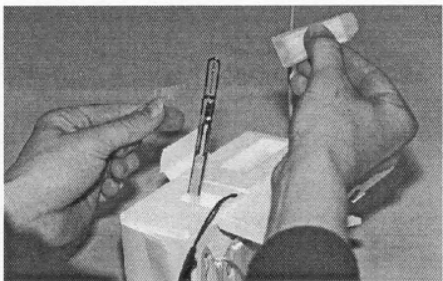


Figure 4

Also remove the small plastic holder from the sensor boom (in the event that it did not fall off already).

When finished, proceed normally with the ground check and/or sounding.

APPENDIX C

EQUIPMENT RESPONSIBILITIES AND REPORTING

1. Introduction

The upper air equipment is among the most complex and costly apparatus located at the aerological facility. Since the observer is not authorized to perform repairs on this equipment, it is imperative that damage and malfunctions be reported without delay to the Regional Contact.

If you observe or foresee; hazards, malfunctions, anomalies, shortages of aerological equipment or materials, that could potentially compromise the safety of station personnel, buildings or the integrity of the aerological program it is your responsibility to report them.

When reporting a problem, the observer should focus on observing “symptoms” and following the instructions provided by the regional Contact, rather than finding the actual “fault”. It is important to recognize that an equipment error may be caused by an underlying fault which needs to be identified. This can only be accomplished by means of a systematic and thorough approach while employing good communication skills.

WARNING

Under no circumstances shall the observer attempt unauthorized repairs of the aerological equipment.

2. System Error(s)

If an error occurs during the operation of the system :

- 1) Record the error as shown on the system display;
- 2) contact the Regional Contact for further instructions.

NOTE

It is important that the Regional Contact be contacted before proceeding further as critical information regarding the error may be obtained using additional System features.

- 3) Complete an AMS Discrepancy report « View Discrepancies » after the sounding;
- 4) complete and transmit an administrative message.

3. PC Error(s)

If an error occurs during the operation of the aerological PC :

- 1) Record the error as shown on the screen display;
- 2) follow instructions as provided by the “Scandisk” program;
- 3) complete an AMS Discrepancy report after the sounding;
- 4) complete and transmit an administrative message.

4. Damage

If damage to any of the aerological buildings or equipment occurs :

- 1) Do not attempt repairs;
- 2) contact the Regional Contact for further instructions.

5. PC Defrag

It is recommended to “defragment” the aerological computer’s hard drive on a weekly basis. This task should be performed every Monday morning after the 1200 UTC sounding :

- 1) Using the Microsoft Windows “Start” button, select the “Run...” option;
- 2) when the “Run” window appears; type in the word **defrag** if not already present (Figure C-1).

NOTE

The “Scandisk” program may be started manually in this fashion as well.

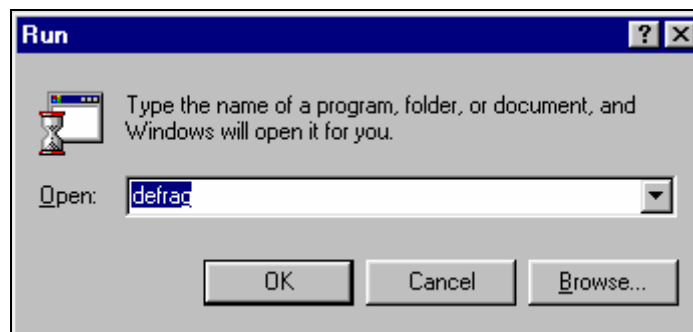


Figure C-1

- 3) Left-click the **OK** button; a “Select Drive” window will appear, prompting for the drive to defragment (Figure C-2).

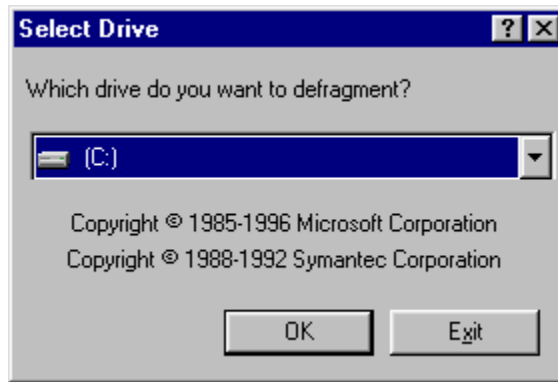


Figure C-2

- 4) Ensure (C:) is displayed then Left-click the **OK** button;
- 5) follow the instructions as provided by the “Defrag” program.

6. Packing and Re-Indexing

It is good practice to “Pack” and “Re-Index” the AMS database on a weekly basis. To perform this task, follow the instructions in section 4.8.

7. Formatting

Occasionally, floppy diskettes may need to be formatted (erased) upon the instruction of the Technical Services Office or Regional Contact.

CAUTION

The Windows Operating System, Metgraph or other programs may be deleted or become inoperative if the observer deviates from the instructions below :

- 1) Insert the floppy disk to be formatted in the floppy drive of your PC;
- 2) double-click the “My Computer” icon on the PC Desktop (Figure C-3).

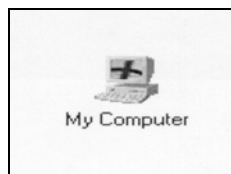


Figure C-3

The “My Computer” window will appear listing the Hard Drive(s) and Floppy Drives(s) available on your computer.

- 3) Select “3½ Floppy (A:)” by left-clicking the mouse;
- 4) select “File” then “Format..” on the main menu (Figure C-4).

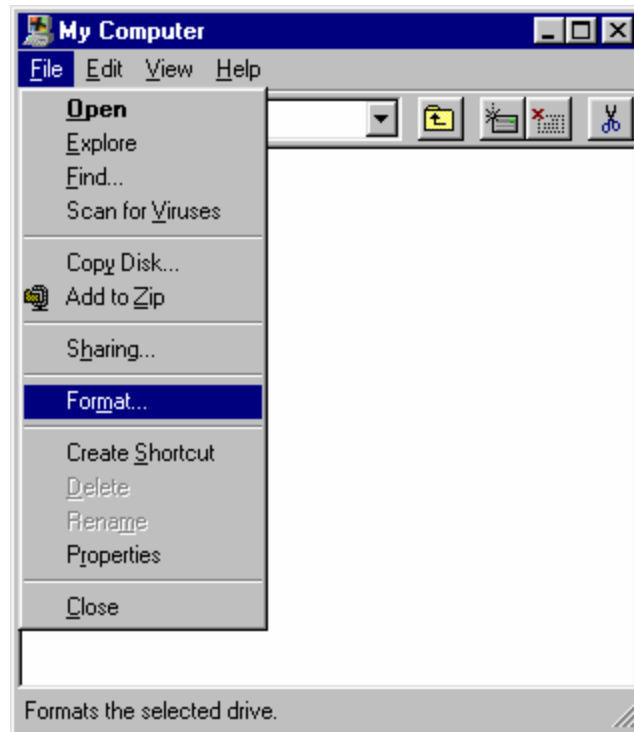


Figure C-4

A “Format” window will appear indicating the drive Capacity, Format Type and Other Options.

- 5) Verify the window displays Format - 3 ½ Floppy (A:), the drive Capacity is 1 . 44 Mb (3 . 5 ”) and there is a “bullet” beside QUICK (erase) (Figure C-5);

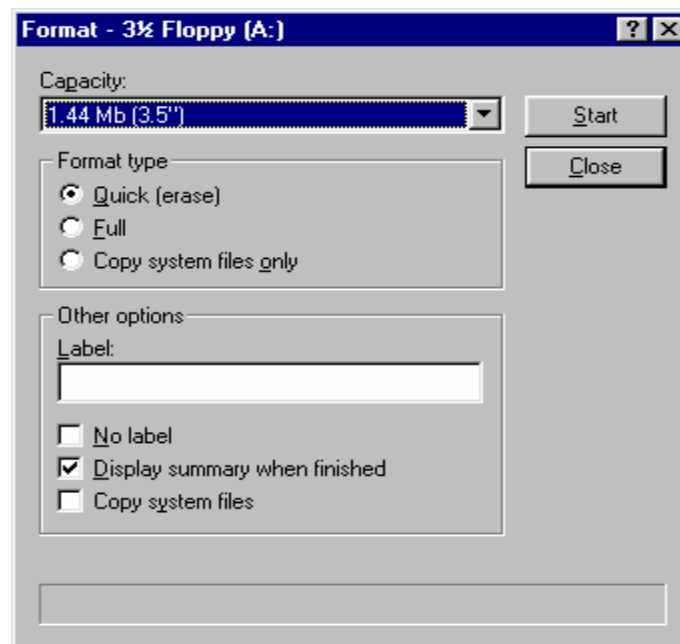


Figure C-5

CAUTION

If the settings are not as shown in Figure C-5, do not proceed. Change the settings or contact the Regional Contact for instructions.

- 6) Click on the **Start** button on the “Format” window.

The formatting will take less than 1 minute, at which time a “Format Results” window will appear (Figure C-6).

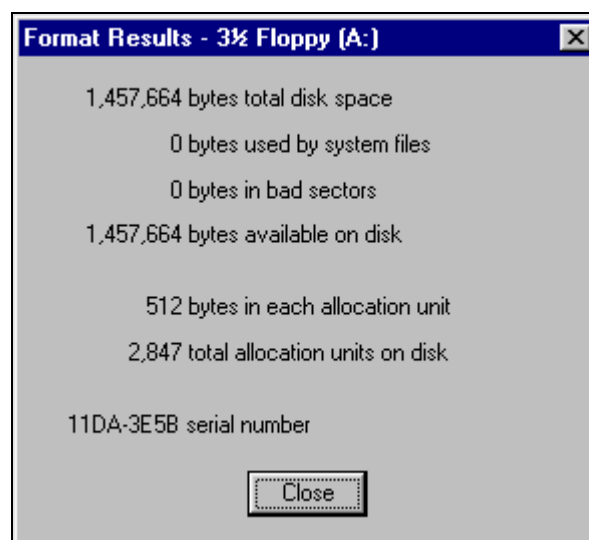


Figure C-6

- 7) Click on the “**Close**” button on the “Format Results” window;
- 8) click on the “**Close**” button on the “Format 3½ Floppy (A:)” window.

NOTE

If more than one diskette is to be formatted, insert a new diskette and click on the **Start** button again.

- 9) Close the “My Computer” window to complete the task.

8. PC Restarting

Occasionally the aerological PC may “crash” or “hang-up”. Several symptoms may be observed, such as; the disappearance of the mouse pointer, an hourglass symbol for a prolonged period of time or black-out of the PC Monitor. There are several ways to restart or “re-boot” a PC. The preferred method is a “soft” re-boot using the keyboard’s **Ctrl, Alt** and **Delete** keys :

- 1) Depress and hold the **Ctrl** and **Alt** keys on the PC keyboard with the left hand;
- 2) depress and release the **Delete** key on the PC keyboard with the right hand.

NOTE

You may have to depress the **Delete** key more than once.

The computer monitor will black out and the operating system will go through its normal boot-up sequence. At some point the sequence may be interrupted by the Scandisk program.

- 3) Follow the instructions provided by Scandisk until the PC monitor displays the Windows 95 Desktop.

NOTE

If **Ctrl-Alt-Delete** fails to restart the computer, the observer may perform a “hard” reboot :

- a. Power-off the PC using the CPU’s power button;
- b. wait 1 minute then power-up again;
- c. follow the instructions provided by “Scandisk”.

9. Diskette Care

In order to ensure diskette integrity is maintained, a number of precautions must be taken when preparing, using and storing diskettes :

- 1) Use laser labels or a felt tip pen when identifying diskettes;
- 2) do not touch the “mylar” surface of diskettes;
- 3) insert diskette properly and in a drive compatible with the type;
- 4) after use, return diskettes to their envelopes, boxes or containers;
- 5) do not expose diskettes to temperature extremes or direct sunlight;
- 6) keep diskettes away from magnetic or metallic objects (including the top or sides of the CPU);
- 7) keep diskettes free from dust;
- 8) protect from shock and do not disassemble.

APPENDIX D

GLOSSARY OF TERMS

- A -

AC (Alternating Current)

An electric current that reverses its direction at regularly recurring intervals.

Accuracy

- The absence of errors or mistakes; correctness; exactness.
- The closeness of an indication or reading of a measuring device to the actual value of the quantity being measured. Usually expressed as a \pm percentage.

Adaptor

- A mechanism or device for attaching non-matching parts.
- A device for changing the function of a machine or apparatus.

Aerology

The branch of meteorology that deals with the study of the upper atmosphere.

AGL

Above Ground Level.

Air Mass

A widespread body of air that is approximately homogeneous in horizontal extent, particularly with reference temperature and moisture distribution.

Albedo

The ratio of the light (or electromagnetic radiation) reflected by any surface (or atmosphere) of the earth to that received by it.

Alloy

A metal made by mixing and fusing two or more metals; or a metal and a non metal, i.e. brass is an alloy of copper and zinc.

Alphanumeric

A set of characters composed of both letters and digits.

Altitude

The vertical distance of a level, a point or an object, measured from a reference point (usually mean sea level).

Ambient Temperature

The average or mean temperature of the surrounding air which comes into contact with living things, objects, equipment and instruments.

Ammeter

An instrument used to measure current.

Ampere (Amp)

A unit used to define the rate of flow of electricity in a circuit.

Amplification

The process of drawing power from an external source and to apply it to an input signal so that it produces an output which is essentially an enlarged reproduction of the input signal.

Amplitude

The magnitude of displacement (of a wave) from a mean value.

Aneroid (Barometer)

- Not wet.
- Containing no liquid.

Application Program

A computer program which accomplishes specific tasks, such as word processing.

ASCII (American Standard Code for Information Interchange)

A 7 or 8 bit code used to represent alphanumeric characters. The code used for communication between data processing systems and associated equipment.

ASL

Above Sea Level.

ATC

Air Traffic Control.

Atmospheric Pressure (P)

The weight of a column of air of unit cross section, rising vertically above a point, up to the upper limit of the atmosphere. It is therefore a force applied to a unit area ($P = F/A$).

Azimuth (Angle)

The length of the arc of the horizon (in degrees) intercepted between a given point and an adopted reference direction (usually true north) measured clockwise from the reference direction. Azimuth is expressed in degrees .

- B -**Backup**

- A system, device, file or facility that can be used as an alternative in case of a malfunction or loss of data.
- A person, group or thing that serves as a support or reinforcement.

Baud

A unit of data transmission speed equal to the number of bits (or signal events) per second. Example is 1200 baud = 1200 bits per second.

Binary

- Refers to the base 2 numbering system, in which the only allowable digits are 0 and 1.
- Pertaining to a condition that has only two possible values or states.

Bit (Binary Digit)

The smallest unit of computer information being either 0 or 1.

Boiling Point

The temperature at which a substance in a liquid state transforms into a gaseous state, e.g. the boiling point of water at sea level is 100°C (212°F).

BUFR

Binary Universal Form for the Representation of data.

Bulb (Liquid-In-Glass-Thermometer)

The area at the tip of a liquid-in-glass thermometer that contains the liquid reservoir.

Byte

A series of (six or eight) binary digits processed as a single unit of information. Usually 1 byte equals 8 bits.

- C -**Calibration**

The process of determining, adjusting or checking an instrument so that its reading can be correlated to the actual value being measured.

Celsius (Centigrade)

Measuring temperature scale based on temperature in which 0 degrees is the temperature at which water freezes and 100 degrees is the temperature at which water boils, under normal atmospheric pressure (sea level).

Character

A letter, digit or symbol that is used in the representation of data. A connected series of characters is known as a “character string”.

Climatology

The scientific study of climate.

Communication

Transmission and reception of data among data processing equipment and peripherals.

CPU (Central Processing Unit)

The part of a computer that contains the circuits which control and perform the execution of computer instructions.

CSA

Canadian Standards Association.

Current

The rate of flow of electricity. The unit of measurement is the ampere.

- D -**Data Base**

A large amount of data stored in a well organized manner.

DC (Direct Current)

An electric current which flows in one direction only and is substantially constant in value.

Debug

To eliminate bugs in a software or in equipment.

Decimal

Refers to a base 10 numbers system using the characters 0 through 9 to represent values. Decimals are usually placed between units and tenths of units.

Default

The value(s) or option(s) that are assumed during the operation of computers or other equipment, when not specified by the user.

Degree

An incremental value in a scale i.e. there are 100 degrees between the freezing point and boiling point of water in the Celsius scale and 180 degrees between the same two points in the Fahrenheit scale.

Density

Mass per unit volume of a substance. e.g. grams per cubic centimetre.

Dew-Point Temperature (T_d)

The temperature to which moist air must be cooled in order for it to become saturated with respect to water (100% Relative Humidity).

Dew-Point Depression ($T-T_d$)

The difference between ambient air temperature and dew-point temperature.

Displacement

The measured distance traveled by a point from its position at rest.

DOS (Disk Operating System)

A program used to control the transfer of information to and from a disk.

- E -**Echo**

To reflect received data to the sender, e.g. keys depressed on a computer keyboard are usually echoed as characters displayed on a screen.

Electrical Interference

Electrical noise induced upon signal wires which affects or obscures the desired information.

Electrolysis

The passage of an electric current through a conducting solution which is decomposed in the process. In aerology, electrolysis is used in the manufacture of hydrogen gas.

Elevation

The vertical distance of a point or level affixed to the surface of the earth, measured from mean sea level.

Elevation Angle

The angle between the local horizon and an object in the sky, measured positively from the horizon upwards.

Error

The difference between the value or amount observed and the true (correct) value or amount.

Explosion Proof Enclosure

An enclosure that can withstand an explosion of gases within it and prevent the explosion of gases surrounding it.

Fahrenheit

Measuring temperature scale based on temperature in which 32 degrees is the temperature at which water freezes and 212 degrees is the temperature at which water boils, under normal atmospheric pressure (sea level).

File

A set of related records or data treated as one unit.

Fixed Level

A set of WMO defined altitudes for which wind velocity is reported.

Floppy Disk

A small, flexible disk carrying a magnetic medium in which data is stored for later retrieval and use.

Freezing Point

The temperature at which a substance in a liquid state transforms into a solid state, e.g. the freezing point of water at sea level is 0°C (32°F).

Frequency

- The rate of occurrence of an event over a specified period of time.
- The number of complete cycles per second of an alternating current or any type of wave motion.

Frequency Band

A certain range of frequencies or wave lengths.

FM (Frequency Modulation)

A certain method of sending the signals of a transmitter, by changing the frequency of the carrier waves, where the amount of frequency change is proportional to the stimulus applied.

Gain

The amount of amplification used in an electrical circuit.

GCOS

Global Climate Observing System.

Geopotential Metre (gpm)

A unit of measurement used in aerology. Unlike the standard metre, which is a measure of distance, the geopotential metre is a measure of energy and takes into account the differing effects of gravity with changing latitudes. In Canada, the value for the geopotential metre corresponds very closely to the standard metre (1 gpm = 0.98 m).

GPS (Global Positioning System)

A satellite based navigational system which can be used to determine the location (position and elevation) of an object capable of receiving GPS satellite signals.

Greenhouse Effect

The heating effect exerted by the atmosphere upon the earth due to the absorption and re-emittance of infrared radiation.

Ground

The electrical “neutral” having the same potential as the surrounding earth, e.g. the connection of an electrical conductor with the earth.

GUAN

GCOS Upper Air Network.

Hardcopy

Output in a permanent form (usually a printout) rather than in temporary form such as on a computer disk or screen.

Hardware

The electrical, mechanical and electromechanical equipment and parts associated with a computing system.

Heat

Thermal energy. Heat is expressed in calories or British Thermal Units (BTU).

Heat Sink

A body which can absorb thermal energy.

HectoPascal (hPa)

A unit of pressure (SI) equivalent to 100 Pascals.

Height

- The vertical distance of a level, point or object measured from a specific datum.
- The vertical dimension of an object.

Helium

A rare, gaseous chemical element first discovered in the sun's atmosphere. It is a very light, colorless, inert gas. Much used in balloons and dirigibles.

Hydrogen

A colorless, odorless, gaseous chemical element that burns easily and weighs less than any other known element. Hydrogen combines chemically with oxygen to form water.

Hygristor

A humidity sensing element composed of fused semi-conductor materials which exhibit a large change in resistance proportional to a small change in humidity.

Hz (Hertz)

The unit of measurement of frequency. Synonymous with cycles per second.

ICAO

International Civil Aeronautical Organization. The international body governing the operation of commercial aircrafts.

Interface

The means by which two systems or devices are connected and interact with each other.

Interpolation

The process of estimating unknown intermediate values from known discrete values of a dependent variable.

Interrupt

To stop a process in such a way that it can be resumed.

Intrinsically Safe

An instrument or device that will not produce a spark or any thermal effects which could ignite a specified gas mixture.

Isobar

A line depicting equal or constant pressure, with respect to either space or time.

Jet Stream

The term applied to a more or less spatially continuous maxima of wind speed located in the upper troposphere (usually at the tropopause).

- K -**Kilo**

An SI prefix meaning thousand, e.g. one kilogram = one thousand grams.

- L -**Lag**

A time delay between the output of a signal and the response of the instrument to which the signal is sent.

Lapse Rate

The rate of change in temperature with height, measured in °C/km. During an aerological sounding, a positive lapse rate is indicated by a decrease in temperature with height and a negative lapse rate shows an increase in temperature. A zero lapse rate would indicate no change in temperature. The average lapse rate is defined as the rate of change in temperature with height, of a particular layer of air, regardless of individual lapse rate changes within the layer. Superadiabatic lapse rate implies a decrease in temperature with height, greater than 9.8 °C/km.

LCD

Liquid Crystal Display.

LED

Light Emitting Diode.

Long-wave Radiation

Generally equated with terrestrial irradiance emitted by the earth and the atmosphere (wavelengths of 4 to 100 µm).

LORAN

Long Range Navigation (System).

µm

A measurement of wavelength equivalent to 10^{-6} metres. Generally referred to as a micrometre.

Mandatory Level

A set of WMO defined pressure values for which the values of altitude, temperature, humidity and wind are reported.

Mega

- An SI prefix meaning million, e.g. one megahertz = one million hertz.
- When referring to computer memory capacity one megabyte = 1,048,576 bytes.

Mean (Temperature)

The average of the maximum and minimum temperatures recorded during a specified period.

Maximum (Temperature)

The warmest temperature recorded during a specified period.

Melting Point

The temperature at which a substance in a solid state transforms into a liquid state.

Meteorological Bulletin

An electronic, coded message comprising meteorological information and a “header” required for identification and transmission purposes.

Micro

- Prefix meaning very or abnormally small, e.g. microclimate.
- An SI prefix meaning millionth, e.g. one microamp = one millionth of an ampere.

Milli

An SI prefix meaning thousandth, e.g. one millivolt = one thousandth of a volt.

Minimum (Temperature)

The coldest temperature recorded during a specified period.

Modem (Modulator/Demodulator)

A device which transforms digital signals into audio tones for transmission over telephone lines and performs the reverse for reception of signals.

- N -**NAVAID (Navigational Aid)**

A global system of navigation which consists of widely separated transmitters on the earth's surface. Using triangulation it is possible to determine the location of an instrument (Navaid receiver) if three or more Navaid transmitter signals are received. GPS (Global Positioning System) is also considered a Navaid, although it is satellite based.

Network

A group of computers which are connected together by communications lines to share information and resources.

NOAA

National Oceanic and Atmospheric Administration (USA).

NWS

National Weather Service (USA), forms part of NOAA.

- O -**Ohmmeter**

An instrument used to measure electrical resistance.

Omni directional

All directions.

Open Circuit

The lack of contact in an electrical circuit.

Operating System

A collection of programs which controls the overall operation of a computer and performs such tasks as assigning places in memory to programs and data.

Ozone (O₃)

A colorless, unstable gas with a pungent odor and powerful oxidizing properties.

- P -**Peripheral**

A device that is external to the central processing unit (CPU) and main memory of a computer, e.g. a printer, modem, etc.

Phase

A time based relationship between a periodic function and a reference.

Pixel (Picture Element)

Definable points on a display screen which are used to form images on the screen. The more the pixels, the higher the image resolution.

Port (Computer)

A signal input or output point.

Potentiometer

A variable resistor often used to control a circuit.

Power Supply

A separate unit or part of a circuit which supplies power to the rest of the circuit or to a system.

Precision

The closeness of agreement between independent measurements of a single quality obtained by applying a stated measurement procedure several times under prescribed conditions.

Program

A list of instructions which a computer follows to perform a task.

PSIG (Pounds per Square Inch Gauge)

Pressure referenced to ambient air temperature.

Psychrometer

A device, having dry-bulb and wet-bulb thermometers, used to determine the amount of moisture in the air.

PTU

Pressure, Temperature and Relative Humidity.

- Q -

- R -

Radiation

The process of giving out light, heat or other energy.

Radiosonde

A small radio transmitter, usually carried aloft by a lighter than air balloon, which broadcasts information about atmospheric conditions (temperature, pressure and humidity). A name apparently derived by H. Hergesell from a combination of the words “radio” for the onboard radio transmitter and “sonde”, which means messenger from old English.

Radiosonde System

A system which has the equipment capable of receiving and processing meteorological data from a radiosonde.

Range

Values between specified upper and lower limits, which are to be measured.

RAOB

An observation using a balloon borne radiosonde to obtain a vertical profile of the atmosphere in terms of pressure, temperature and humidity. RAOB is a contraction for radiosonde observation.

RAWIN

A program used to obtain the velocity of the winds aloft by tracking a transmitting device (radiosonde) or a target, by radio methods. RAWIN is a contraction for Radio Wind.

Rawinsonde System

A system which has the equipment capable of tracking and recording the trajectory of a radiosonde, from which the wind speed and direction can be calculated.

Relative Humidity (Rh)

A ratio used to express the amount of water vapor present in the atmosphere. It is usually calculated with respect to liquid water even when the temperature is below freezing and it is expressed as a percentage.

Relay (Mechanical)

An electromechanical device which completes or interrupts an electrical circuit by physically moving contacts to touch each other.

Relay (Solid State)

A solid state switching device which completes or interrupts an electrical circuit without the use of moving parts.

Reset (Clear)

To restore an instrument or device to a prescribed initial state.

Resistance

The resistance to the flow of electric current, measured in ohms (Ω).

Resolution

The smallest detectable increment of measurement.

ROM (Read Only Memory)

Computer memory which contains readable fixed data that cannot be changed in any way.

Scroll

To move all or part of a computer screen's image up or down, left or right, to allow unseen information to appear.

Sensing Element

That part of a transducer which reacts directly in response to input.

Sensitivity

The minimum change in input signal to which an instrument can respond.

Short-Wave Radiation

Solar radiation with a peak intensity of $0.5 \mu\text{m}$ and confined within the wavelengths of 0.3 to $3\mu\text{m}$.

SI (Système International)

The name given to the standard metric system of units.

Signal

An electrical transmission (either input or output) which conveys information.

Significant Level

A pressure value in an aerological sounding deemed to be of importance with respect to temperature, relative humidity or wind velocity.

Software

Programs assembly loaded into a computer from external mass storage. Software is also extended to include operating systems and documentation.

Sounding (Aerology)

A plot of the vertical variations of weather elements observed in the atmosphere above a point.

Specific Gravity

The ratio of the mass of any material to the mass of the same volume of pure water at 4°C.

Station Index

A 5 digit number assigned by the WMO, used in meteorological bulletins to identify the observing stations.

Strata (Stratum)

Synonymous with layer; a vertical portion of the atmosphere sampled by a radiosonde.

Stratosphere

The region of the atmosphere, above the troposphere and below the mesosphere, in which temperature increases with height.

Synoptic

- Pertaining to or affording an overall view.
- In meteorology, the use of data obtained simultaneously over a wide area for the purpose of presenting a comprehensive and nearly instantaneous picture of the state of the atmosphere.

Syntax

The rules governing the structure of a language.

- T -

Tape (Computer)

A recording medium for data or computer programs. Tape may be in permanent form such as perforated paper tape or erasable such as magnetic tape.

Teflon (Trademark of DuPont)

A fluorocarbon polymer normally used as a sealant or insulator.

Telecommunication

Synonym for data communication. The transmission of information from one point to another.

Telemetry

The electronic transmission of information from a distant source.

Terminal (Computer)

An input/output device used to enter data into a computer and record the output.

Thermistor

A temperature sensing element composed of fused semi-conductor materials which exhibit a large change in resistance proportional to a small change in temperature.

Transducer

A device (or medium) which converts energy from one form to another This term is generally applied to devices which take physical phenomena (pressure, temperature, humidity, etc.) and convert them to electrical signals.

Tropopause

The boundary between the troposphere and stratosphere, characterized by an abrupt change of lapse rate (usually from positive to near zero).

Troposphere

That portion of the atmosphere from the earth's surface to the tropopause, characterized by a general decrease of temperature with height.

- U -

Ultraviolet

That portion of the electromagnetic spectrum below blue light.

UPS (Uninterruptible Power System)

Equipment consisting of a charger, battery, converter, transformer and processor, capable of providing electrical power (for a period of time), when local line power is unavailable.

UTC

Universal Time Coordinated (after the French equivalent).

Vacuum

- An empty space utterly devoid of matter, even air.
- A pressure less than normal atmospheric pressure.

Velocity

The rate of displacement over a period of time expressed in units of direction and speed (magnitude).

Volt

Unit of measurement of the EMF equivalent to the force required to produce a current of 1 amp through a resistance of 1 ohm..

Voltage

An electrical potential between two points in a circuit which can be measured in volts.

Voltmeter

An instrument used to measure voltage.

- W -**Wet Bulb Temperature (T_w)**

The lowest temperature to which a parcel of air can be cooled by evaporating water into it. If the air is originally saturated, evaporation cannot take place. In this case, the wet bulb temperature of the saturated air is the same as the air temperature (which is also equal to the dew-point temperature).

Wind

Air in motion, relative to the earth's surface.

Window (Computer)

A defined area in a screen having its own commands and in which information is displayed..

WMC

World Meteorological Centre.

WMO

World Meteorological Organization. The United Nations body of meteorological agencies and interests.

Word (Computer)

The number of bits treated as a single unit by the CPU.

- X -**- Y -****- Z -****Zulu**

Universal time (UTC) is also called "world time", "Z time" and "Zulu time". The word Zulu is used in communications to signify the letter "Z".

APPENDIX E

HEALTH & SAFETY

Environment Canada will take all appropriate measures to protect and promote the health and safety of its employees, and to protect the health and safety of others while at a Department of the Environment location. It must be understood that health and safety shall not be sacrificed for expediency, and that unacceptable performance of health and safety responsibilities by any employee will not be tolerated.

Workplace Hazards

Whether working with Helium, Hydrogen or conducting Supplementary Programs at the aerological facility, a number of workplace hazards exist.

1. OVERHEAD DOORS

Overhead doors at aerological facilities vary in design but are all large and very heavy. The door is normally supported by spring or counterweight mechanisms to assist the observer during operation. A large overhead door, in good repair, will increase the success and timeliness of an aerological release. To minimize the risk of personal injury or damage to the equipment, several established practices must be followed when operating overhead doors :

1. Open and close the door slowly (do not force);
2. keep the chains parallel to each other, to prevent the cables from coming off their track;
3. utilize the “hand over hand” method using body weight to assist instead of pulling or jerking with arm(s) and back muscles;
4. do not wrap the chain around your hand or wrist;
5. if supporting cables or other mechanisms break or let go, do not attempt to grab the chains or prevent the door from dropping;
6. in the winter months, remove any snow and ice accumulation from the outside door panels and doorway;
7. report all malfunctions to your supervisor or Regional Support Desk.

2. LADDERS

A stepladder or extension ladder may be required when replacing light bulbs or performing other maintenance such as calibrating the gas detection system. As with all ladders, there are several rules of thumb to follow :

3. Inspect the ladder before use. Do not use a broken, bent, or damaged ladder, or one that is not rated for your body weight;
4. plan or visualize the steps you will take to perform the task and identify possible obstructions or hazards;
5. set ladder at the proper angle (75°) using the 1 to 4 rule. The ladder base should be a distance equal to $\frac{1}{4}$ of the working length of the ladder away from the base of the vertical support;
6. always have at least 3 points of contact when climbing (i.e. 2 feet/1 hand or 2 hands/1 foot);
7. do not overreach;
8. when using a stepladder, do not stand or sit on top.

3. AEROLOGICAL RELEASES

A release is usually accomplished by lightly holding the radiosonde instrument in one hand and the balloon (by the neck) with the other hand. The assembly is taken to a suitable area and the balloon is released. The lighter-than-air balloon rises, pulling the radiosonde from the observer's hand. If an aerological release is not successful, the time and energy as well as the equipment costs invested in the Pre-flight preparation, is defeated. The observer must make every reasonable effort to ensure the success of the release while taking the necessary precautions for personal safety.

Very little physical strength is required to carry out an aerological release during agreeable weather conditions, however, when inclement weather is present, the release demands quick and short bursts of physical exertion as well as significant dexterity. Depending on the existing circumstances, a number of aerological release hazards may be present for any given day;

A) Falling, Tripping, Slipping and Entanglement

Consider and visualize the release prior to attempting. Ensure the surface which you will walk or run on is free of obstructions, ice or liquids. Check the radiosonde and balloon assembly to ensure it is in order. Avoid impractical footwear such as sandals. Allow plenty of time to complete the task (do not rush!).

B) Aircraft

The radiosonde instrument, the balloon and the train may represent a hazard to aircraft navigation in certain areas. Environment Canada has notified the aviation community with the location and program times of the aerological stations operating within Canada. In addition, local notification procedures may have been developed for the station and these must also be followed by the observer.

C) Electrocutation

No attempt shall be made to remove a radiosonde, train or balloon from power lines, transmitting antennas or any other source which carries or is suspected of carrying an electrical current. Severe burns or death may result from coming into contact with power sources while holding onto the radiosonde instrument. If the equipment becomes entangled, the appropriate personnel must be notified immediately.

D) Thunderstorm

No attempt shall be made to release a radiosonde instrument during an electrical storm at the site. Several types of radiosonde trains increase the possibility of a lightning strike at or near the observer's immediate location. Releasing in a thunderstorm cell also increases the risk of damage or loss of the radiosonde and balloon. The observer should wait until the storm has moved downstream or subsided.

E) Visibility

Poor visibility affects the observer's ability to recognize release obstructions, tripping hazards and other dangers such as wildlife. The release area should be kept well lit and clear of obstructions such as snowdrifts. If wildlife sightings are a concern, an extra person should attend the release to serve as a "spotter".

F) Strong Winds

"Eddies" created by strong winds disturb the normal path of the balloon near the aerological facility. Planning and preparing for an aerological release greatly increases the likelihood of success. During windy conditions, the observer should prepare by "rehearsing" the release. This is accomplished by exiting the inflation room through the centre of the overhead doorway, without carrying the balloon and instrument. While walking away from the building, the observer should note the direction and strength of the wind, then determine a suitable location for the release.

G) Explosion

The possibility of damaging the balloon during the release exists. If hydrogen is used as an inflation gas and the balloon is damaged, there is a risk of igniting an explosive mixture of hydrogen and air. Every precaution should be taken not to damage the balloon. The radiosonde must be kept below the neck of the balloon at all times when using hydrogen gas.

H) Working Alone

An observer “check in” procedure has been established at each aerological station, depending on the personnel and resources available. This usually involves notifying someone that the release has been successful and that the sounding is under way. This procedure is for the observer’s safety and must be adhered to at all times.

4. RADIOSONDE BATTERY

A) HAZARDS

The power source for the radiosonde instrument is a water activated battery which supplies DC (Direct Current). When the battery is dry, very few hazards are anticipated, however it is possible for the battery to emit toxic copper fumes if it is involved in a fire. Breathing copper fumes may cause “metal fume fever”. Symptoms include a metallic taste, chills, fever, aches, coughing and chest tightness.

When the battery is activated in water, the liquid formed in the battery, as well as the remaining activation water will contain copper chloride which has been designated by the International Maritime Organization as a “severe” marine pollutant. Copper chloride is extremely toxic to algae and fish. Eye and skin contact with the liquid may cause irritation, redness, pain and may deposit a brown pigment at the edge of the cornea. If the liquid is ingested, it may cause severe illness and/or death from shock or kidney failure. It is important to utilize the appropriate personal protective equipment (PPE) during the activation and handling of the radiosonde battery. The composition of the radiosonde battery is as follows :

- Magnesium alloy,
- copper chloride,
- sulfur,
- graphite,
- copper,
- non-woven hydrophilic fabric.

B) FIRST AID MEASURES - RADIOSONDE BATTERY

1) EYE CONTACT

Immediately flush using the eyewash station (at least 20 minutes) and forcibly hold eyelids apart to ensure complete irrigation of all eye and eyelid tissue. Remove contact lenses if applicable. Seek immediate medical attention.

2) SKIN CONTACT

Immediately wash area of contact with soap and water. Remove and clean contaminated clothing and shoes. If irritation develops seek immediate medical attention.

3) INHALATION

Remove victim to fresh air. If respiratory irritation develops seek medical attention immediately.

4) INGESTION

Never give anything by mouth to an unconscious or convulsing victim. If victim is conscious, immediately give 3 to 4 glasses of water and induce vomiting by touching fingers to the back of the throat. Place victim in sitting position with the head lower than the hips to prevent aspiration. Seek medical attention or poison control centre immediately.

5. DRY CHEMICAL FIRE EXTINGUISHERS [TYPE ABC]

A) HAZARDS

Multi-purpose Type ABC dry chemical fire extinguishers are the most common type of extinguishers located at the aerological facility. Fire extinguishers are under pressure and should be kept away from heat sources. These extinguishers may be used on ordinary combustible material, flammable liquids and electrical fires. The extinguishing agent consists of;

- Monoammonium phosphate 55-90%
- ammonium sulfate 2-37%
- mica 1-3%
- attapulgus clay 1-3%
- amorphous silica 0.5-2.5%
- methylhydrogen polysiloxane 0.3-1%

B) FIRST AID MEASURES - DRY CHEMICAL FIRE EXTINGUISHERS1) EYE CONTACT

Immediately flush using the eyewash station (at least 20 minutes) and forcibly hold eyelids apart to ensure complete irrigation of all eye and eyelid tissue. Remove contact lenses if applicable. Seek immediate medical attention.

2) SKIN CONTACT

Immediately wash area of contact with soap and water.

3) INHALATION

Remove victim to fresh air. Administer artificial respiration if required. Seek medical attention immediately.

4) INGESTION

Do not induce vomiting. Never give anything by mouth to an unconscious or convulsing victim. If victim is conscious, immediately give 1 or 2 glasses of water. If vomiting occurs, keep airway clear and give more water. Seek medical attention or poison control centre immediately.

6. MERCURY [Hg]**A) HAZARDS**

Mercury is one of the most toxic chemicals in our environment. It evaporates at room temperature and will continue to emit toxic vapours if it is left untreated. It may cause severe medical problems such as early senility, increased incidents of birth defects, liver damage and loss of fine motor control. Mercury is a silvery white, odorless liquid. It is also very heavy (13 times heavier than water).

B) FIRST AID MEASURES - MERCURY1) EYE CONTACT

Immediately flush using the eyewash station (at least 20 minutes) and forcibly hold eyelids apart to ensure complete irrigation of all eye and eyelid tissue. Remove contact lenses if applicable. Seek immediate medical attention.

2) SKIN CONTACT

Immediately flush with water while removing contaminated clothing and shoes. Wash area with mild soap until no evidence of chemical remains. Discard non rubber shoes and wash clothing before re-use. Seek immediate medical attention.

3) INHALATION

Remove victim to fresh air. Administer artificial respiration if required. Seek medical attention.

4) INGESTION

Do not administer anything by mouth to the victim if unconscious or convulsing. If victim is conscious immediately give 2 to 6 glasses of water and induce vomiting by touching fingers to the back of the throat. Place victim in sitting position with the head lower than the hips to prevent aspiration. Seek medical attention or poison control centre immediately.

7. HELIUM [He]**A) HAZARDS**

Helium cylinders are stored for use as a primary or back-up inflation gas for aerological balloons. Although helium is an inert gas, inhalation may cause asphyxiation, lung damage or death. If Helium is inhaled, the victim may lose consciousness quickly and without warning. The usual result is an uncontrolled fall which may cause serious injury.

B) FIRST AID MEASURES - HELIUM [He]**1) EYE CONTACT**

Nil.

2) SKIN CONTACT

Nil.

3) INHALATION

Remove victim to fresh air. Administer artificial respiration if required. Seek medical attention immediately.

4) INGESTION

Nil.

8. DE-ICER [Methyl Alcohol]**A) HAZARDS**

De-icer (Methyl Alcohol) is used to remove frost and ice from various sensor components. De-icer has several synonyms including Methanol and Wood Alcohol. It is stored and used in pure (100%) form. It is severely poisonous and may be fatal or cause blindness if swallowed. It is also harmful if inhaled or absorbed through the skin.

De-icer is also extremely flammable in liquid or vapor form and causes skin, eye and respiratory tract irritation. Several other hazards are associated with this liquid, including liver and central nervous system disorders.

B) FIRST AID MEASURES - DE-ICER [Methyl Alcohol]1) EYE CONTACT

Immediately flush using the eyewash station (at least 20 minutes) and forcibly hold eyelids apart to ensure complete irrigation of all eye and eyelid tissue. Remove contact lenses if applicable. Seek immediate medical attention.

2) SKIN CONTACT

Immediately wash area of contact with soap and water. If skin irritation persists, seek medical attention.

3) INHALATION

Remove victim to fresh air. Administer artificial respiration if required. Seek medical attention immediately.

4) INGESTION

Induce vomiting. Do not administer anything by mouth to the victim if unconscious or convulsing. Seek medical attention or poison control centre immediately.

9. Mercury Spill Kit

A) HAZARDS

The most common type of mercury spill occurs from the breaking of mercury thermometers. The amount of mercury in a standard thermometer varies from 1 to 4 grams while the amount contained in a mercury barometer is considerable more.

Mercury begins to vaporize at a temperature of 1°C, therefore time is crucial when attempting to clean up a spill. The clean up must be prompt and meticulous. The clean up site should not only be considered as where mercury is visible, but also the immediate area around the spill should be treated. Note that the most common method of contamination is through foot gear worn during the clean up.

Mercury Spill Clean-up Kits are provided at all aerological facilities. The kit in use at aerological facilities is distributed by EPS Chemicals Inc.(Mercon®). Some of the chemicals within the kit may react with carbides, aluminum, bleach and strong oxidants therefore caution must be exercised when using the contents of the kit.

The chemicals included, work to change mercury into solid, stable, vaporless salts. They include :

1) MerconWipes

Towelettes pre-charged with MerconVap concentrate. Used to clean countertops, hands and equipment.

2) MerconSpray

Brown liquid, to be sprayed above, on and around a mercury spill to suppress vapours.

CAUTION

MerconSpray is flammable.

3) MerconVap

Brown liquid, used to cover the mercury and the area around a spill to suppress vapours

CAUTION

Slightly different composition than MerconSpray but still flammable.

Each kit also contains :

- Material Safety Data Sheets (MSDS),
- chemical resistant gloves,
- protective eyewear,
- clean-up instructions,
- shipping instructions and materials,
- mercury storage containers (ABS plastic).

NOTE

Some kits may include “MerconTainers”, however these are being replaced with ABS plastic containers which have a larger capacity.

B) FIRST AID MEASURES - MERCURY SPILL KIT (MERCON CHEMICALS)

1) EYE CONTACT

Immediately flush using the eyewash station (at least 20 minutes) and forcibly hold eyelids apart to ensure complete irrigation of all eye and eyelid tissue. Remove contact lenses if applicable. Seek immediate medical attention.

2) SKIN CONTACT

Immediately wash area with mild soap until no evidence of chemical remains. Remove contaminated clothing and shoes. If irritation develops seek immediate medical attention.

3) INHALATION

Remove victim to fresh air. Administer artificial respiration if required. Seek medical attention.

4) INGESTION

Do not administer anything by mouth to the victim if unconscious or convulsing. If victim is conscious immediately give milk. Do not induce vomiting. Seek medical attention or poison control centre immediately.

C) Mercury Spill Clean-up Instructions

Prior to attempting a mercury spill clean up, several safeguards must be followed :

- 1) Exercise caution when walking on surfaces treated with Mercon chemicals as they may become slippery;
- 2) never attempt a mercury spill clean up if you are pregnant;
- 3) be aware of potential “sleeping” hazards in cracks and corners of a spill area. Clean them well;
- 4) exercise caution when walking near a spill area. Remember that shoes are the most probable cause of spreading mercury contamination therefore protect the spill area from any traffic;
- 5) if a mercury spill occurs outdoors during cold weather and clean up is not possible, ensure that a clean up is attempted in the spring by spraying the spill area with diluted (10:1) water and MerconVap. Any visible mercury is to be cleaned up as per the instructions below.

PPE (Personal Protective Equipment) required for a mercury spill clean up is composed of :

- Chemical resistant gloves,
- protective eyewear,
- rubber boots (recommended).

Note that mercury spills are normally the result of an accident which may have contaminated a person or persons in the area. Ensure FIRST AID MEASURES for mercury are followed prior attempting a clean up. The established procedure for attempting mercury spills is as follows :

- 1) Open all windows and turn OFF heating and/or ventilation (if applicable);
- 2) check clothing and footwear for mercury and remove contaminated apparel;
- 3) while using PPE, spray MerconSpray (if the spill is indoors) in ambient air, starting at head level and continue downwards to floor level. Also spray over the visible spill;

- 4) cover all visible mercury with MerconVap liquid;
- 5) using MerconWipes, work from the outer area of the spill to push the mercury droplets and glass pieces inwards towards a center point;
- 6) carefully pick up pieces of debris and mercury then place in the plastic bag provided;
- 7) re-cover the entire spill area with MerconVap liquid. Leave for 24 hours if possible. If the spill is located in a high traffic area, clean the liquid after 5 minutes using paper towels or cloth and perform a final clean up with the MerconWipes;
- 8) remove the gloves, place in the plastic bag provided and seal the bag with contaminated material in the ABS Storage Container;
- 9) complete a Hazardous Occurrence Investigation Report.

NOTE

More detailed information may be obtained from the Instruction Manual supplied with the Kit, or, by contacting EPS at 1-800-663-8303.

10. Fire Safety

For the observer's safety, it is necessary to know the location of fire fighting equipment, including extinguishers and fire alarm pull stations. It is also very important to know the types of fires for which various extinguishers were designed. Fire extinguishers will be labeled to identify the type of fire for which they are to be used. There are 4 (four) different classes of fires :

A) Class A

Ordinary combustible solids such as paper, rubber and textiles. This type of fire frequently produces flaming or toxic gases and often leaves hot ash or residue which are capable of re-igniting.

B) Class B

Flammable liquids such as gasoline. Spreading of this type of fire is commonly encountered if the vessel holding the liquid is overturned. Remember that the pressure from an extinguisher may spread the flame or overturn a vessel.

C) Class C

These are Type A or B fires in which electrical equipment is involved. If the power is shut down, this type of fire may be considered Type A or B depending on the material(s) involved. It is highly recommended not to use water on these fires even if power is OFF, as some electrical equipment will store a charge. The risk of electrocution exists in Class C fires.

D) Class D

These fires consist of reactive metals such as lithium, sodium, potassium or active hydrides such as potassium hydroxide [KOH]. KOH is used at some aerological facilities in the manufacture of hydrogen gas for balloon inflation. Class D fires burn with an extremely hot flame and often produce toxic gases.

Observers should only attempt to extinguish small fires when they are confident the fire can be extinguished rapidly without threat to personal safety or the safety of others. In the event that the observer chooses not to attempt fighting a fire, the observer must :

- 1) Notify the appropriate personnel (fire department);
- 2) activate the fire alarm and warn others;
- 3) evacuate the workplace;
- 4) meet the fire fighters at the building and direct them to the fire;
- 5) contact the Regional Contact.