Coding Aircraft Meteorological Observations

Aircraft operating in Antarctica are asked by the WMO to provide meteorological observations for use in weather forecasting. If your aircraft is fitted with AMDAR equipment, the system will automatically compile and transmit aircraft meteorological observations and you need take no further action. Otherwise you are asked to compile the routine meteorological observations from the aircraft into bulletins and transmit them in AIREP or CODAR format to your local GTS centre.

AIREP reports

At the moment few National Meteorological Centres use the official WMO aircraft code form of CODAR. It appears preferable to use the ICAO aviation code form of AIREP for reporting aircraft observations, and pilots should be familiar with this. The report consists of position, time and ICAO flight level or QNH height at which the aircraft is flying, followed by a weather report covering some or all of the following items in order: the air temperature (tenths deg C if possible), the computed direction and wind speed (knots) at the way point, turbulence, aircraft icing and supplementary information. The duty meteorologist at the Antarctic Meteorological Centre or elsewhere will code up the observations. Batches of observations should be prepared each hour and sent to the GTS by the normal route for synoptic observations.

These observations should be carried out by aircraft on high altitude long distance flights, and are made at each way point. Observations are not required if another aircraft has already made an observation within the last three hours at the same way-point and the aircraft is within 50 hPa of the pressure level of the previous observation, however if two aircraft are flying at the same pressure level and make observations within 30 minutes of each, the temperatures and wind vectors may be averaged.

AIREP Definition.

An AIREP is an in-flight evaluation usually made over areas where weather information is limited or nonexistent (for example, over an ocean).

AIREP Code format

Note: If information is not available transmit a / for that entry.

CCCC	ICAO of transmitting unit.
AIREP	Type ARP (Routine AIREP) or ARS (Special AIREP). Will precede all AIREP text. See Table below for ARS conditions.
Aircraft Number	Reported as a seven-character group. The identifier will be a combination of numbers and letters.
Latitude	Four figures indicating the latitude of the aircraft to the nearest minute followed by the letter N (North) or S (South).
Longitude	Five figures indicating the longitude of the aircraft to the nearest minute followed by the letter E (East) or W (West).
UTC Time	Four figures depicting time to the nearest minute. For AIREP corrections, add one minute to the actual time.

Flight Level	A four-character group (the letter F followed by three figures), representing the aircraft altitude in hundreds of feet (e.g., F370).
Temperature	Two figures indicating the temperature in whole degrees Celsius preceded by “PS” (plus) or “MS” (minus).
Spot Wind	A wind group. The first three figures indicate true wind direction in degrees. The last two figures indicate wind speed to the nearest knot. In the following code: DDD = True wind direction at current position; SS = Wind speed at current position. If the wind is above 99 knots use three figures.
Turbulence	Severe turbulence is reported as TURB SEV and moderate turbulence as TURB MOD - when turbulence in cloud is experienced INC is added. TURB SEV is reported immediately on occurrence and this requires an AIREP SPECIAL (ARS), otherwise TURB MOD is reported only if it occurs within the last 10 minutes prior to reaching the position.
Icing	Severe aircraft icing is reported as ICE SEV. Moderate aircraft icing is reported as ICE MOD. ICE SEV is reported immediately on occurrence and this requires an AIREP SPECIAL (ARS), otherwise ICE MOD is reported only if it occurs within the last 10 minutes prior to reaching the position.
Supplementary Information	Cloud bases and /or tops are reported as BASE and/or TOP followed by the respective height indication F(number) or (number)M or (number)FT. Thunderstorm tops may be reported by TS TOP followed by the flight level. Other abbreviations include: Present weather – RA (rain), SN (snow), FZRA (freezing rain), FC (funnel cloud), TS (thunderstorm), FRONT (front). Clouds – SCT (scattered), BKN (broken), CNS (continuous), CB (cumulonimbus). To correct an AIREP, add 1 minute to the initial time and add a remark (e.g., COR 1814) when the correction is transmitted as the last entry.

Meteorological Conditions Requiring Special AIREP (ARS).

Thunderstorms (see note)	Severe Icing
Tropical Storm	Severe or Extreme Turbulence
Squall Line	Mountain Wave Turbulence
Hail	Widespread Sandstorm
Widespread Duststorm/Sandstorm	Volcanic Eruption or Ash Cloud

Note: The requirement for thunderstorms refers to the occurrence of an area of widespread activity, thunderstorms along a line with little or no space between individual storms, or thunderstorms embedded in cloud layers or concealed by haze. It does not refer to isolated or scattered thunderstorms not embedded in clouds or concealed in haze.

Supplementary information that can be reported includes: turbulence, towering thunderstorms etc.

AIREP Examples.

Aircraft BA G-ABCD at 42°30’N 20°20’W at 1610 UT; flying at 19,000 feet on altimeter

setting of 1013.2 hPa; temperature minus 34°C; wind 230 degrees 45 knots ; front passed at 42°N 16°W; continuous cloud; base of layer above aircraft 20,000 feet, top of layer below aircraft 16,000 feet; moderate icing and turbulence at front.

CCCC ARP BAGABCD 4230N 02020W 1610 F190 MS34 23045
FRONT 42N016W CNS BASE F200 TOP F160 TURB MOD AND ICE MOD AT FRONT

A recent GTS example:
CCCC ARP QFA56 4136S 17012E 0400 F340 MS56 20631=

A special report example:
CCCC ARS MA00153 4951N 05010W 0510 F350 MS48 26030 TS TOPS 450

Note: This AIREP was transmitted as a Special AIREP (ARS) because the aircrew verbally reported the thunderstorm activity as covering a widespread area.

The following bulletin is a recent example assimilated by the ECMWF

USAA01 EGRR 062238
EGAR ARP VPFBQ 6600S 06634W 1957 F180 MS32 22034=
EGAR ARP VPFBQ 6300S 06406W 2048 F190 MS37 22038=
EGAR ARP VPFBQ 6000S 06205W 2135 F190 MS37 20033=

CODAR reports

At the moment few National Meteorological Centres use the official WMO aircraft code, which is given below for information. It appears preferable to use the ICAO aviation code form of AIREP for reporting such observations.

Meteorological observations should be carried out by aircraft on long distance flights and made at each way point. Observations are not required if another aircraft has already made an observation within the last three hours at the same way-point and the aircraft is within 50 hPa of the pressure level of the previous observation, however if two aircraft are flying at the same pressure level and make observations within 30 minutes of each, the temperatures and wind vectors may be averaged. The information required from the aircraft is the ICAO flight level or QNH height at which the aircraft is flying, whether CAT is present (none, moderate or severe), the air temperature (tenths deg C if possible) and the computed direction and wind speed (knots) at the way point. The duty meteorologist at the Antarctic Meteorological Centre or elsewhere should code up the observations. Batches of observations should be prepared each hour and sent on the GTS using the normal route for synoptic observations.

CODAR Code format

The simplest form of the CODAR code is:

LLXX
YYGGg $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $P_aP_aP_aB_zS_h$ $TTT_an_sn_m$ ddfff=

Meaning of the symbols:

LLXX	Bulletin header, given at the start of each set of observations
YY	Day of month, with 50 added to indicate wind speed in knots
GGg	Hours and tens of minutes (truncated), UT

$L_aL_aL_a$	Latitude in tenths degree
Q_c	Quadrant of globe (5 for west, 3 for east)
$L_oL_oL_oL_o$	Longitude in tenths degree
$P_aP_aP_a$	Actual pressure for ICAO pressure level in whole hPa
B_z	Type of CAT (0=none, 1=moderate, 2=severe)
S_h	Type of temperature and height data. (4 for simplest form)
TTT_a	Temperature in tenths deg C. Odd if negative, even if positive.
n_s	Number of spot winds (normally 1)
n_m	Number of mean winds (normally 0)
dd	wind direction to nearest 5 degrees. The 5 or 0 is added to the first digit of the wind speed
fff	wind speed in knots.

If necessary the ICAO pressure level needs to be computed from the given height and rounded to a suitable nominal pressure; a sample programme is appended. For example:

Flight Level	Nominal Pressure (hPa)	Computed Pressure (hPa)
FL50	850	843
FL100	700	697
FL180	500	506
FL240	400	392
FL300	300	301

Example observations:

Charlie: 30th 00:12 700 hPa, no CAT, -23.2, 12 knots @ 345
Delta:30th 00:38 710 hPa, no CAT, -21.1, 20 knots @ 320

Code to:

LLXX
80001 99693 50682 70004 23110 34512=
80003 99702 50682 71004 21110 32020=

Example Waypoints

Rothera - Fossil Bluff

R36	99676	50681
Alpha	99682	50681
Bravo	99689	50682
Charlie	99694	50682
Delta	99702	50682
Echo	99708	50682
Kg	99713	50683

Rothera - Stanley

6666	99660	50666
6364	99630	50641
MIDAL	99600	50620
5760	99570	50603
5459	99540	50588
Stanley	99517	50578 (SFAL)
MPA	99517	50584 (EGYP)

Appendix: Pascal program to compute pressure of flight levels.

```
program flight_level_to_pressure;

uses crt;

var
   i,
   code : integer;
   pressure,
   temp1,
   multiplier,
   height,
   QNH : real;
   ch : char;
   flight_level : string;


begin
     clrscr;
     writeln;
     writeln(' This program computes a pressure altitude from a flight level');
     writeln(' using the ICAN standard atmosphere.');
     writeln;
     writeln(' The ICAN atmosphere is virtually identical to the ICAO standard atmosphere,');
     writeln(' and was the only one for which JDS could find equations.');
     writeln;
     writeln(' There are three ways to enter the flight level:');
     writeln;
     writeln('1.  You can enter it as a number if the plane is operating on the ICAO');
     writeln('    standard setting of 1013.2 hPa - the Dash normally uses this.  eg 180');
     writeln('2.  You can enter it in 1000 feet and will then be prompted for');
     writeln('    QNH - the Otters normally report this.  eg 11K');
     writeln('3.  You can enter the actual height in feet for low level flying, again you');
     writeln('    will be prompted for QNH.  eg 500''');
     writeln;
     writeln('Hit a key to continue');
     repeat until keypressed;
     ch := readkey;
     repeat
           multiplier := 100;
           clrscr;
           writeln;
           write(' What is the flight level eg 180, 11K or 500'' ? ');
           readln(flight_level);
           for i := 1  to length(flight_level) do flight_level[i] := upcase(flight_level[i]);
           if pos('K',flight_level) > 0 then begin
              write('What is QNH ? ');
              readln(QNH);
              delete(flight_level,pos('K',flight_level),1);
              multiplier := multiplier * 10;
           end else QNH := 1013.2;
           if pos('''',flight_level) > 0 then begin
              multiplier := 1;
              write('What is QNH ? ');
              readln(QNH);
              delete(flight_level,pos('''',flight_level),1);
           end;
     val(flight_level,height,code);
     height := height * multiplier * 0.3048;   { feet to metres }
     temp1 := (288.15-0.0065*height)/288.15;
     pressure := exp(5.2559*ln(temp1))*QNH;
     {5.2559 = 1 / (a * R / g) a=0.0065 deg / m, R = 28.705, g =980.665 }
     writeln;
     writeln(' Pressure altitude =',pressure:5:0,' hPa');
     writeln;
     writeln(' The computed value needs rounding to something suitable.  As guidance here are');
     writeln(' some standard flight level pressure altitudes and the exact equivalent:');
     writeln;
     writeln(' FL50  = 843 => 850 hPA');
     writeln(' FL100 = 697 => 700 hPa');
     writeln(' FL180 = 506 => 500 hPa');
     writeln(' FL240 = 392 => 400 hPa');
     writeln(' FL300 = 301 => 300 hPa');
     writeln;
     writeln('Now decide on your rounding for',pressure:5:0,' hPa');
```

```
     writeln;
     writeln('Hit a key to continue or Q to finish');
     repeat until keypressed;
     ch := readkey;
     until ch in ['q','Q'];
end.
```