

VORTEX DATA MESSAGE

Both the abbreviated and detailed vortex data messages are transmitted in an alphabetical manner. In each report, a letter of the alphabet is followed by information about the center of the tropical circulation. This information includes such items as lat/long of the center, temperatures inside and outside of the eye of the storm, wind information, minimum pressures, etc.

Sample report:

URNT12 KNHC 051237

VORTEX DATA MESSAGE

A. 05/1237Z

B. 30 DEG 59 MIN N

77 DEG 16 MIN W

C. 700 MB 2695 M

D. 65 KT

E. 050 DEG 80 NM

F. 313 DEG 78 KT

G. 063 DEG 32 NM

H. 954 MB

I. 11 C/ 3082 M

J. 15 C/ 3108 M

K. 13 C/ NA

L. CLOSED WALL

M. C25

N. 12345/7

O. 1/1 NM

P. AF984 1606A FRAN OB 14

MAX FL WIND 105 KT NE QUAD 1051Z. STADIUM EFFECT.

MAX FL TEMP 17C 130/10 NM FROM FL CENTER.

Breakdown of the message:

MESSAGE HEADER. The first line of the message is the code used to identify a vortex message in various meteorological data bases, followed by the date and time (Zulu) the message was transmitted.

A. DATE AND TIME OF FIX. The time when the center of the storm was located or "fixed". 05/1237Z means the report is from the fifth day of the month, at 1237Z. "Z" means Zulu time, or Greenwich Mean Time (CDT + 5 hrs). Therefore, 1237Z = 7:37 a.m. Central Daylight Savings Time.

B. LATITUDE AND LONGITUDE of the vortex fix in degrees and minutes.

Example: 30 DEG 59 MIN N 77 DEG 16 MIN W.

Use this information to plot up the latest location of the storm center; comparing the current position to previous positions gives the latest movement of the storm. But be aware that sometimes storms "wobble", or make sharp turns, so listen to the latest National Hurricane Center forecasts if you want to know where the storm might be headed next!

C. MINIMUM HEIGHT AT STANDARD LEVEL. Standard level refers to certain "slices" of the atmosphere used by meteorologists around the world. The exact altitude of each of these slices relates to the pressure. *The lower this height is below the "standard" height indicates how low the pressure is inside the hurricane*; stronger storms have lower pressures. The number reported is in meters. Hurricane Hunters fly storms at the "**surface**" (500 to 1500 feet above the water), **925 millibars** (2500 feet or 762 meters), **850 mb** (4780 ft or 1457 m), or **700 mb** (9880 ft or 3011 m). The aircraft will fly using an autopilot set to follow a constant *pressure altitude*. For example, when flying a mission at 700 mb, the aircraft's pressure altimeter will read 9,880 feet all day. But as the plane flies into lower pressure, the plane will actually be flying closer to the ground. A *radar altimeter* bounces radar pulses off the ground and tells the crew how high they actually are, and the meteorologist uses this number to calculate the *height of standard surface*. In the example above, the 700 millibar height was 2695 meters, which is 316 meters lower than the standard height of 3011 meters: a significant low pressure! When flying low-level (below 1500 feet) this block is reported as **NA** (Not Applicable).

D. ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED IN KNOTS. *65 kt* means the highest estimated *surface wind* is 65 knots on this particular inbound leg. The flight meteorologist looks at the sea surface and can estimate how strong the winds are by what the sea looks like. At particular wind speeds, the sea begins to form white caps, then patches of foam, then some of the foam patches begin to appear green, etc. The key word here is "observed"; the meteorologist may not see the highest surface winds because of darkness, heavy rain or clouds, so often this number is lower than the maximum flight level wind. A "knot" is a nautical mile (nm) per hour. **To convert** to miles per hour, use 1.15 miles/nm; 65 nm/hr x 1.15 mi/nm = 75 miles per hour. To convert to meters per second, cut knots in half: 65 kt = 33 m/s. If not observed at all, this block is reported as NA (Not Applicable).

E. BEARING AND RANGE FROM CENTER OF THE MAXIMUM SURFACE WIND given in degrees and nautical miles. The "bearing" is the direction from the center in which the surface wind was seen, reported in degrees (similar to compass headings, except these bearings are in reference to "true" instead of "magnetic" north). Due north is 0 degrees, east is 90 degrees, south is 180 degrees, and west is 270 degrees. The bearing in the example is 050 degrees, which means the surface wind was seen northeast of the center. To pinpoint where this was, you also need to know how far away it was: the "range". In this case, the 65 knot wind reported in part D was found 80 nautical miles (92 statute miles) northeast of the center.

F. MAXIMUM FLIGHT LEVEL WIND NEAR STORM CENTER. The highest wind seen on the last 100 mile leg inbound to the storm. There may be stronger winds in other sections of the storm (see remarks in Item P). These winds are at *flight level*, and were measured directly by the aircraft's instruments. In the example, the peak wind was 313 degrees 78 knots, which means the wind was blowing from a direction of 313 deg (northwest) at a speed of 78 kts (using the 1.15 mph/kt conversion, that's 90 miles per hour). *Together with pressure (Items C and H),*

winds give an idea of how strong the storm currently is .

G. BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND. Same method as reporting bearing and range for the surface winds (see Item E, above). In this example, the 78 knot flight level wind reported in Item F was found 063 degrees (northeast) of the center, and 32 nautical miles from the center. Usually the strongest winds are found in the "eyewall" surrounding the eye, and this gives an idea of how large the center (or eye) of the storm is.

H. MINIMUM SEA LEVEL PRESSURE computed from dropsonde or extrapolation. This is one of the key pieces of information which tell how strong the storm is. "Standard" sea level pressure is 1013 millibars. Since hurricanes, tropical storms, and tropical depressions are all low-pressure systems, the pressure reported here is almost always lower than standard. The lower the pressure, the more intense the storm. The word "EXTRAP" precedes any pressures extrapolated from aircraft sensor information; if the word "EXTRAP" is not there, it means the pressure was measured directly by a dropsonde released from the aircraft, and is usually more accurate. This lowest pressure is found in the center of the storm. Millibars can be converted to inches of Mercury using 0.0295 in-Hg/mb. In the example, the pressure of 954 mb is approximately 28.14 in-Hg. For reference, developing storms may have pressures around 1007 mb, most hurricanes are below 980 mb, and the lowest pressure measured in an Atlantic/Gulf of Mexico hurricane was 888 mb (Hurricane Gilbert). There may be small fluctuations in pressure due to normal, daily pressure rises and falls.

I. MAXIMUM FLIGHT LEVEL TEMPERATURE / PRESSURE ALTITUDE OUTSIDE THE EYE. This gives an idea of the general temperature surrounding the storm. "Standard" temperature at 700 mb (where we fly most hurricanes) is about -5 degrees Celsius, but in the tropics, it's usually 10 to 15 degrees warmer than "standard". What you especially want to *look for* is how it compares to the temperature inside the eye, in Item J or P. The example shows a temperature of 11 degrees Celsius (52 degrees Fahrenheit) at an altitude of 3082 meters (10,112 feet). The altitude is included because the airplane bumps up and down due to turbulence and other factors, and minor changes in the temperature may be due to changes in altitude.

J. MAXIMUM FLIGHT LEVEL TEMPERATURE / PRESSURE ALTITUDE INSIDE THE EYE. This is yet another indicator of how "healthy" the storm is. One of the unusual features of a hurricane is that it is warmer inside the eye than outside. What you want to *look for* here is how much warmer it is than the temperature reported outside the eye in Item "I." A developing storm may be only a degree warmer inside the center, while a strong hurricane may be 10 degrees warmer. In this example, the eye temperature of 15 degrees Celsius (59 degrees Fahrenheit) is four degrees warmer than the temperatures immediately outside the eye. Be sure to look at the remarks in Item "P" to see if there was an even warmer temperature found inside the eye (but more than 5 miles from the fix position). The aircraft was at a pressure altitude of 3108 meters (10,198 feet).

K. DEWPOINT TEMPERATURE / SEA SURFACE TEMPERATURE INSIDE THE EYE. This is the "dewpoint" measured in the center of the storm. Dewpoint is a measure of the humidity. If the dewpoint and the temperature are exactly the same, the humidity is 100%. The formula for converting to relative humidity is too complicated to explain here, but the lower the dewpoint is, compared to the air temperature, the drier the air. In the example, the dewpoint was 13 Celsius (compared to a temperature of 15 Celsius), for a relative humidity of 87%. If the humidity is at or near 100%, it may mean the center is filled with clouds near the altitude of the aircraft, while a "healthy" hurricane may have a clear, drier eye. The second part of Item K is no longer used, as the aircraft do not carry the infrared sensors needed to measure sea surface temperature.

L. EYE CHARACTER. This is a brief description of what the eye looks like on radar. "CLOSED WALL" if the eye is completely surrounded by a ring of thunderstorms: the wall cloud. "OPEN NE" means there is a break in the wall to the northeast, etc. If the eye is not at least 50% surrounded by a wall cloud, this item and Item M will be reported as "NA" (Not Applicable).

M. EYE SHAPE ORIENTATION AND DIAMETER. *Eye shapes* are coded as follows: **C-circular; CO-concentric; E-elliptical.** Orientation of major axis of ellipse is transmitted in tens of degrees, and all *diameters* are transmitted in nautical miles. Example: E09/15/5 means elliptical eye oriented with major axis thru 90 degrees (and also 270 degrees), with length of major axis 15 nm, and length of minor axis 5 nm. CO8-14 means concentric eye with inner eye diameter 8 miles, and outer diameter 14 miles. The "healthiest" hurricanes usually have a small, circular eye. A concentric eye (a ring inside a ring) is a relatively rare phenomenon that may signal a temporary weakening while the storm reorganizes. An eye diameter that shrinks (compared to the previous vortex message) may signal strengthening: just as a twirling ice skater spins faster as she pulls in her arms, a hurricane may "spin" faster as its eye gets smaller. Eye diameters are usually 10-20 nautical miles, while we sometimes see them as small as 5 nm to as large as 60 nm.

N. FIX DETERMINED BY / FIX LEVEL. The first string of numbers indicates what the meteorologist used to find the center of the storm, using numbers 1 through 5, as follows:

1-Penetration, 2-Radar, 3-Wind, 4-Pressure, 5-Temperature.

After the solidus ("/"), you'll find one or two numbers which show at what level(s) the center was found, as follows:

0-surface, 1-1500 ft, 8-850 mb, 7-700 mb, 5-500 mb, 4-400 mb, 3-300 mb, 2-200 mb, 9-925 mb.

Example: 1235/7 means the fix was determined by four means: penetration, radar, winds, and pressure. The fix was made at 700 mb (approx 10,000 feet). If a calm spot was seen on the surface of the water, the fix level could have been "07" to indicated the surface and the 700 mb center were found within 5 nm of each other.

O. NAVIGATION FIX ACCURACY / METEOROLOGICAL ACCURACY. These numbers give an estimate of how accurate the position is. "Navigation accuracy" is a gauge of how well the navigation equipment is operating. The "Meteorological Accuracy" depends on how well the storm center can be defined by the meteorological data: if there is a sudden, sharp wind shift, and the temperature peak and pressure drop all coincide, the met accuracy will be a small number. A weaker storm will probably have a larger met accuracy. Both numbers are reported in nautical miles.

P. REMARKS SECTION. Always starts with the Mission ID:

MISSION IDENTIFIER. The first line of the remarks is a unique identifier for each mission:

AFXXX AABBC NAME

Agency: Either AF for the Air Force Reserve Hurricane Hunters or NOAA for the National Oceanic and Atmospheric Agency aircraft

XXX: Tail number of the aircraft

AA: Total number of missions flown on this storm system

BB: Depression number (or "XX" if it's not a depression or greater)

C: Ocean basin. "A"=Atlantic, "C"=Central Pacific, "E"=Eastern Pacific

NAME: Storm name, or words CYCLONE (for depression) or INVEST. Example: AF984 1606A FRAN means Air Force Reserve aircraft number 984 is flying the 16th mission on Hurricane Fran, which is the 6th tropical cyclone of the season in the Atlantic/Gulf/Caribbean.

The flight meteorologist may add details of anything he or she feels are interesting to note. There are some standard remarks: "MAX FL WIND 105 KT NE QUAD 1051Z" reminds the public that while the highest wind seen just prior to hitting the center this time around was 78 knots (Item F), a stronger wind was seen earlier in the flight: 105 knots at 1051Z (5:51 a.m. CDT), in the northeast quadrant of the storm. Another standard remark is given anytime a temperature peak is seen more than 5 nm from the center location: "MAX FL TEMP 17C 130/10 NM FROM FL CENTER" says the highest temperature seen at flight level ("FL") was 17 Celsius, located 10 nautical miles in a direction of 130 degrees (to the southeast). Finally, the meteorologist lets you know Fran has a "STADIUM EFFECT", a rare but lovely phenomenon in which the clouds form a solid wall all around the eye, and stretch up and outward to reveal a circle of clear sky above, similar to a football stadium that's 50,000 feet tall! Take the cyberflight if you would like to see some pictures of the stadium effect.