

# **Enigma Airspace file format**

This document describes the Enigma airspace file format.

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Comments are welcome: [info@MGLAvionics.co.za](mailto:info@MGLAvionics.co.za)

## ***Airspace format***

The airspace file has a fixed name when used with an instrument, however any file name could be used. The default filename is "AIRSPACE.EVD". ".EVD" is the general file extension to describe a Enigma vector data file.

The airspace file contains regions, controlled airspaces and special use airspaces.

Within this file an unrestricted number of airspace records are stored.

Each airspace record contains a fixed size data portion, a flexible size data portion and a list of points that form a regular, non-self intersecting polygon describing the location and outline of the airspace. Each airspace may be defined using more than one polygon. A typical example of where this is used is if an airspace crosses the date line (E180 to W180). In order to simplify processing of such airspaces, two airspaces are defined, one in the eastern, the other in the western hemisphere. Please note that your software must be able to handle the definition of the bounding rectangle crossing the date line. This is indicated by the North West longitude having a positive value while the South East longitude has a negative value.

Each airspace record has the following format:

Type	longint. The type of airspace for this record. Format see below. Note: also used at the start of the file to indicate optional file options. See text on file options in this document.
North West Lat	longint. North West latitude of a bounding rectangle.
North West Long	longint. North West longitude of a bounding rectangle.
South East Lat	longint. South East latitude of a bounding rectangle.
South East Long	longint. South East longitude of a bounding rectangle.
Pointer Next	longint. Pointer to next record in file.
Pointer Points	longint. Pointer to points of the polygon.
Frequency 1	longint. Contact frequency in Khz.
Frequency 2	longint. Alternate contact frequency in Khz.
Upper Altitude	longint. Upper altitude limit for airspace. Format see below.
Lower Altitude	longint. Lower altitude limit for airspace. Format see below.
ICAO	string. ICAO designation for airspace.
Name	string. Name of airspace.
Class	string. Airspace class if not special use airspace.
Exception	string. Optional qualification for airspace.
Comm-name	string. Radio contact name or phrase.
Level	string. Qualifier for upper/lower altitude.
Times	string. Operating time or time based restrictions.
Weather	string. Weather related restrictions.

-start of polygon points data-

Size longint. Total number of points in polygon(s).

Latitude[Size],Longitude[Size] array of longint pairs describing points of polygon.

Lat=200.0, long=0: end current polygon, start new polygon.

## Data types

### *Type*

If the type identifier is the first item in the file (at file address bytes 0-3), the type may be a standard type identified by bits 8-31 all zeros. In this case the file contains a linear list of airspaces.

If the type identifier equals the value 0xFFFF0001 the file is a tiled airspace file. See text on tiled airspace files in this document.

If bits 8 to 31 are zero, we have a standard airspace type identifier as follows:

Regions, controlled and uncontrolled airspaces

- 01 - ADVISORY AREA (ADA) OR (UDA)
- 02 - AIR DEFENSE IDENTIFICATION ZONE (ADIZ)
- 03 - AIR ROUTE TRAFFIC CONTROL CENTER (ARTCC)
- 04 - AREA CONTROL CENTER (ACC)
- 05 - BUFFER ZONE (BZ)
- 06 - CONTROL AREA (CTA) (UTA)
  - SPECIAL RULES AREA (SRA, U.K. ONLY)
- 07 - CONTROL ZONE (CTLZ)
  - SPECIAL RULES ZONE (SRZ, U.K. ONLY)
  - MILITARY AERODROME TRAFFIC ZONE (MATZ, U.K. ONLY)
- 08 - FLIGHT INFORMATION REGION (FIR)
- 09 - OCEAN CONTROL AREA (OCA)
- 10 - RADAR AREA
- 11 - TERMINAL CONTROL AREA (TCA) OR (MTCA)
- 12 - UPPER FLIGHT INFORMATION REGION (UIR)

Special use airspaces

- 32 - ALERT
- 33 - DANGER
- 34 - MILITARY OPERATIONS AREA
- 35 - PROHIBITED
- 36 - RESTRICTED
- 37 - TEMPORARY RESERVED AIRSPACE
- 38 - WARNING

### ***Latitude and longitude***

Latitude and longitude follow the standard Enigma format as follows:

Position latitude and longitude are stored as signed 32 bit integers (little endian).

Degrees are multiples of the value 180000 and any degree fraction is a multiple of 1/180000.

Degrees North and East are positive while degrees South and West are negative.

Example: North 45 degrees, 59 minutes, 30 seconds is 8278500.

Example: North 0 degrees, 30 minutes, 0 seconds is 90000.

## ***Frequencies***

Frequencies are stored in a longint in units of Khz. For example: The frequency 124.8Mhz is stored as 124800.

## ***String***

In this file a string is always stored. An empty string is stored as a single byte of value zero.

A string with content is stored as the first byte containing the length of the string, immediately followed by the contents of the string. Another string or other data may follow in the byte immediately above the last character of the string. A string can never be more than 255 characters in length. This form of string is compatible with the Pascal "shortstring".

## ***Level***

This one character string may contain either one of the following characters:

B – Airspace is relevant both for high and low level flight operations.

L – Airspace relevant for low level only

H – Airspace relevant for high level only

## ***Altitude (high,low)***

Altitudes consist of a three bit code in the lower three bits of the longint value while the remainder contains a value where required (flight level or altitude in feet after shifting right three bits).

Code

0 - Low altitude - > SURFACE, High altitude UNLIMITED

1 - altitude in feet AMSL

2 - altitude in feet AGL

3 - flight level

4 - GROUND (only used with Low altitude)

5 - By NOTAM (low, high altitude meaningless in data file)

6 - Undefined (source data has no definition for altitudes)

## ***Polygon***

The array of points starts with a single longint describing the number of points in the polygon. The polygon is always of closed type and the last point in the polygon has the first point as "next". Software should close any open polygons that have the last vertex missing.

Polygons are separated by the special point value of latitude 200 and longitude 0.

On encountering this value, the drawing routine should close the current polygon and start a new polygon with the next point in the list.

Polygons are always closed with the value latitude 200 and longitude 0. Every polygon defined in the data has this value as last item.

### ***Tiled airspace file***

In order to accommodate fast operations in areas that contain a large number of airspaces, the file format can be modified by having the first type identifier in the file with a value of 0xFFFF0001.

In this case the first type value is immediately followed by a list of 648 file pointers. Each file pointer is a pointer to a 10x10 degree tile starting with latitude N90, longitude W180. The second entry contains a pointer to the tile latitude N90, longitude W170. 36 tiles per row and 18 rows. The last pointer points to latitude S80, longitude E170.

The coordinate refers to the top left corner of the tile.

Each tile contains all the airspace definitions relevant to this tile PLUS an overlap of 5 degrees on each side. Tiles at the outside fringes of the array do not have the 5 degree overlap into what would be illegal coordinates. The tile contains any airspace that is fully or partially contained in this area or completely surrounds it. The individual airspaces follow the same format as is described in this document. The last airspace in the tile has the "next" pointer as zero value.

Any equipment using this file format may focus on the relevant tile rapidly by consulting the list of tile pointers at the beginning of the file and positioning the file access pointer to the location given in the pointer. If a tile is empty (i.e. Contains no airspaces), the relevant pointer entry at the beginning of the file reads 0 and the file contains no data for this tile.

Example tiled airspace file start:

```
Location 0x0      0xFFFF0001
Location 0x4      0x00000000 // no data for latitude W180-W170, longitude N90-N80
Location 0x8      0x0002034C // data for W170-W160, longitude N90-N80 starts at file
                  location 0x0002034C
```

Total 648 pointers

Please note: all 32 bit integers are stored as little endian values (Intel format)

### ***Comments***

The airspace vector data specifies only polygons rather than a more complex combination of arcs, circles, ellipses and other shapes. Curved parts of an airspace are reduced to an appropriate series of polygon vertexes that provide a close fit for the airspace boundary.

The immediate advantage of this is fast determination if one is currently within a particular airspace or not using commonly known algorithms.

Each airspace record starts with information on the type of airspace, a bounding box and a pointer to the next record.

While scanning the file, the software need only read this first section of the record to determine if further processing of this record is required. The bounding box describes a

rectangular region (ignoring polar distortions) fully containing the airspace under evaluation.

Should the software not use this data, it can immediately perform a seek to the file location in the pointer to the next record. After fully processing the record, the file pointer will be at the same location.

The airspace file does not dictate the color or line type and thickness of any airspace drawing. This is left to the application to decide.