

**ADDITIONAL MILITARY LAYERS**

**AML Implementation Guidance Document**

**Edition 1**

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**1 INTRODUCTION**

Additional Military Layers (AML) is a unified range of geospatial products designed to satisfy military requirements for situational awareness. AML is defined within NATO STANAG 7170 which specifies a number of product specifications which define the content and structure of specific geospatial data products. AML is intended to be used in military systems to support the planning and conduct of operations. AML includes both vector and gridded data products.

This document provides additional guidance to those implementing AML within software systems on how the various specifications should be used. It highlights differences from the IHO Electronic Navigational Chart (ENC) Product Specification and provides explanations of the components of the product specifications.

AML is intended to be supported in a broad range of systems including Warship Electronic Display and Information System (WECDIS), Command Systems and Tactical Decision Aids (TDAs).

A more general introduction to AML is provided in the AML Handbook which is available from the AML pages of the UKHO website.

AML product specifications are listed in Table 1;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Short Title** | **Product Specification Title** | **Vector/Grid** | **Version** | **Date** |
|  | | | | |
| AMC | ATMOSPHERIC AND METEOROLOGICAL CLIMATOLOGY | Grid | 1.0 | 3rd November 2004 |
| CLB | CONTOUR LINE BATHYMETRY | Vector | 1.0 | 1st November 2001 |
| ESB | ENVIRONMENT SEABED & BEACH | Vector | 1.0 | 1st November 2001 |
| LBO | LARGE BOTTOM OBJECTS | Vector | 1.0 | 1st November 2001 |
| MFF | MARITIME FOUNDATION & FACILITIES | Vector | 1.0 | 1st November 2001 |
| RAL | ROUTES AREAS & LIMITS | Vector | 1.0 | 1st November 2001 |
| SBO | SMALL BOTTOM OBJECTS | Vector | 1.0 | 1st November 2001 |
|  | | | | |
| CLB | CONTOUR LINE BATHYMETRY | Vector | 2.1 | 1st November 2005 |
| ESB | ENVIRONMENT SEABED & BEACH | Vector | 2.1 | 1st November 2005 |
| LBO | LARGE BOTTOM OBJECTS | Vector | 2.1 | 1st November 2005 |
| MFF | MARITIME FOUNDATION & FACILITIES | Vector | 2.1 | 1st November 2005 |
| RAL | ROUTES AREAS & LIMITS | Vector | 2.1 | 1st November 2005 |
| SBO | SMALL BOTTOM OBJECTS | Vector | 2.1 | 1st November 2005 |
| IWC | INTEGRATED WATER COLUMN | Grid | 2.1 | 30th June 2006 |
|  | | | | |
| AML 3.0 | ADDITIONAL MILITARY LAYERS | Vector | 3.0 | 1st August 2008 |
|  | | | | |
| **Unendorsed Product Specifications** | | | | |
| GS-ESB | GRIDDED SEDIMENT  ENVIRONMENT SEABED & BEACH | Grid | 1.0 | 28th July 2005 |

Table 1 – Summary of all AML Product Specifications

**2 REFERENCES**

**IHO DOCUMENTS**

Available from the IHO website [www.iho.int](http://www.iho.int/srv1/index.php?lang=en)

A. S-57 IHO Transfer Standard for Digital Hydrographic Data

B. S-57 Appendix B.1 - ENC Product Specification

C. S-52 Specifications for Chart Content and Display Aspects of ECDIS

D. S-64 IHO Test Data Sets for ECDIS

**NATO DOCUMENTS**

Available from the NATO Standardisation Office Portal https://nso.nato.int/nso/

E. STANAG 4564 - WARSHIP ELECTRONIC CHART DISPLAY INFORMATION SYSTEM (WECDIS)

F. STANAG 7170 - ADDITIONAL MILITARY LAYERS (AML) – DIGITAL GEOSPATIAL DATA PRODUCTS

**AML DOCUMENTS**

Available from the AML pages of the UKHO website http://www.ukho.gov.uk/Defence/AML/Pages/Home.aspx

G. AML Handbook

H. AML Product Specifications

I. AML Production Specification

J. AML Portrayal Specification (available upon request from UKHO to organisations that hold the S-52 Presentation Library)

K. AML Test Data

**3 CONTACT INFORMATION**

For further information about AML including further guidance on implementation, please contact the UKHO;

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<http://www.ukho.gov.uk/Defence/AML/Pages/Home.aspx>

**4 IMPLEMENTATION OF AML**

AML is intended for use within a wide range of systems including the following;

* Navigation Systems (to support situational awareness)
* Command Systems
* Sensor Systems
* Airborne Systems

Requirements for the implementation of AML vary between systems and application. These may include;

* Import
* Display
* Querying
* Export

For Navigation Systems, the Warship ECDIS (WECDIS) STANAG 4564 states the requirement to support AML. However it is necessary to establish more detailed testable requirements to ensure that implementations achieved the expected user experience. In addition specific national requirements may exist which go beyond those detailed in the WECDIS STANAG. Typically systems will already support IHO S-57 ENC and therefore support for AML is largely an extension of this functionality. Key differences are summarised as follows;

1. AML uses a slightly modified ISO 8211 encapsulation see section 6.1 of this document for more information.

2. AML utilizes expanded feature catalogues which defines additional objects and attributes using lowercase names. As a number of versions of AML are in active use it is necessary to support multiple feature catalogues. Section 7 covers these in more detail.

3. Adapted Portrayal Specification, AML extends and adapts the IHO S-52 Presentation Library to provide a default set of display rules and symbols. This does not prohibit more specific display specifications for particular applications. See section 8 for more details.

4. For gridded data products more significant adaptation is required to support the required encapsulations and content of this data.

**5 DATA PRODUCT SPECIFICATIONS**

AML data products are defined in a series of product specifications. This section of the document describes how AML product specifications are divided into component parts. This structure allows the separation of the ‘content’ (Objects and Attributes) and the ‘carrier’ encoding. The various components are described as follows;

**5.1 MAIN DOCUMENT**

These documents define the key requirements and details for the product specification. This includes a data schema which describes the objects and attributes used within a data product.

**5.2 IMPLEMENTATION ANNEXES**

Each product specification has one or more implementation annex which describes how the data content shall be encapsulated into a file using a specific encoding. For Vector data products AML uses the IHO S-57 Exchange Standard and its ISO 8211 encoding to encapsulate content. More details of this encoding is defined in section 6.

Gridded data products utilize the NetCDF format, which is widely used for the exchange of meteorological and other coverage datasets.

**5.3 OBJECT AND ATTRIBUTE CATALOGUES**

Each vector data product specification utilizes an Object and Attribute Catalogue and these are described in section 7.

**5.4 PORTRAYAL SPECIFICATION**

In order to specify how AML content should display within systems a Portrayal specification for vector AML data has been developed and this is described in section 8.

**6 AML S-57 IMPLEMENTATION GUIDANCE**

AML uses the S-57 exchange standard as its encapsulation for vector data products. It utilizes the same ISO 8211 encoding used for ENC. This section described the differences between the AML and ENC S-57 encodings and details specific variances. This will assist implementers when extending an application to support AML products in addition to ENC.

**6.1 COMPARISON BETWEEN ENC AND AML**

This section provides a comparison between the S-57 constructs used within AML and ENC. Refer to Table 2;

| S-57 ConstructS used | AML | | ENC | |
| --- | --- | --- | --- | --- |
| Base cell | Update | Base Cell | Update |
| ***Dataset General Information Record*** |  |  |  |  |
| DSID - Dataset Identification field  *(for AML sub-field variations refer to section 6.3)* | **✓** | **✓** | **✓** | **✓** |
| DSSI - Dataset Structure Information field | **✓** | **✓** | **✓** | **✓** |
| ***Dataset Geographic Reference Record*** |  |  |  |  |
| DSPM - Dataset Parameter field | **✓** |  | **✓** |  |
| DSPR - Dataset Projection field |  |  |  |  |
| DSRC - Dataset Registration Control field |  |  |  |  |
| ***Dataset History Record*** |  |  |  |  |
| DSHT - Dataset History field |  |  |  |  |
| ***Dataset Accuracy Record*** |  |  |  |  |
| DSAC - Dataset Accuracy field |  |  |  |  |
| ***Catalogue Directory Record*** |  |  |  |  |
| CATD - Catalogue directory field | **✓** | **✓** | **✓** | **✓** |
| ***Catalogue Cross Reference Record*** |  |  |  |  |
| CATX - Catalogue Cross Reference field |  |  |  |  |
| ***Data Dictionary Definition Record*** |  |  |  |  |
| DDDF - Data Dictionary Definition field |  |  |  |  |
| DDDR - Data Dictionary Definition Reference field |  |  |  |  |
| ***Data Dictionary Domain Record*** |  |  |  |  |
| DDDI - Data Dictionary Domain Identifier |  |  |  |  |
| DDOM - Data Dictionary Domain field |  |  |  |  |
| DDRF - Data Dictionary Domain Reference field |  |  |  |  |
| ***Data Dictionary Schema Record*** |  |  |  |  |
| DDSI - Data Dictionary Schema Identifier field |  |  |  |  |
| DDSC - Data Dictionary Schema field |  |  |  |  |
| ***Feature Record*** |  |  |  |  |
| FRID - Feature Record Identifier field  *(for AML sub-field variations refer to section 6.3)* | **✓** | **✓** | **✓** | **✓** |
| FOID - Feature Object Identifier field | **✓** | **✓** | **✓** | **✓** |
| ATTF - Feature Record Attribute field | **✓** | **✓** | **✓** | **✓** |
| NATF - Feature Record National Attribute field | **✓** | **✓** | **✓** | **✓** |
| FFPC - Feature Record to Feature Object Pointer Control field |  | **✓** |  | **✓** |
| FFPT - Feature Record to Feature Object Pointer field | **✓** | **✓** | **✓** | **✓** |
| FSPC - Feature Record to Spatial Record Pointer Control field |  | **✓** |  | **✓** |
| FSPT - Feature Record to Spatial Record Pointer field | **✓** | **✓** | **✓** | **✓** |
| ***Vector Record*** |  |  |  |  |
| VRID - Vector Record Identifier field | **✓** | **✓** | **✓** | **✓** |
| ATTV - Vector Record Attribute field | **✓** | **✓** | **✓** | **✓** |
| VRPC - Vector Record Pointer Control field |  | **✓** |  | **✓** |
| VRPT - Vector Record Pointer field | **✓** | **✓** | **✓** | **✓** |
| SGCC - Coordinate Control field |  | **✓** |  | **✓** |
| SG2D - 2-D Coordinate field | **✓** | **✓** | **✓** | **✓** |
| SG3D - 3-D Coordinate field 1 | **✓** | **✓** | **✓** | **✓** |
| ARCC - Arc/Curve Definitions field 2 | **✓** | **✓** |  |  |
| AR2D - Arc Coordinates field 2 | **✓** | **✓** |  |  |
| EL2D - Ellipse Coordinates field |  |  |  |  |
| CT2D - Curve Coordinates field |  |  |  |  |

Table 2 – AML and ENC S-57 comparison

## 6.2 AML S-57 Sub-Field Values

The S-57 implementation annexes of the AML Product Specifications include the specification of certain sub-field values that must be set in the exported files. As there is commonality between ENC values and those required by AML, some of these values are retained. However, there are those that are modified for AML purposes.

Table 3 below provides a breakdown of the Subfield and their values that will be required in AML exported files. Values that are modified specifically for AML are indicated in bold (refer also to the notes below).

**Always refer to the individual AML Product Specifications for further details concerning subfield values.**

| Field/Sub-field | AML Application Profiles | |
| --- | --- | --- |
| Base Application Profile values | Update Application Profile values |
| CATD - Catalogue Directory field | | |
| RCNM - Record name | CD | CD |
| IMPL - Implementation | Examples  .asc=Catalogue files  .bin =Data set files  .txt = Text files  .tif = Picture files  .pdf = Document files  .htm = “ “  .jpg = Photo files  .avi = video/film files  .mpg = “ “ | Examples  .asc=Catalogue files  .bin =Data set files  .txt = Text files  .tif = Picture files  .pdf = Document files  .htm = “ “  .jpg = Photo files  .avi = video/film files  .mpg = “ “ |
| DSID - Dataset Identification field | | |
| **INTU - Intended usage** | See section 0 | See section 0 |
| STED - Edition number of S-57 | 03.1 | 03.1 |
| **PRSP - Product Specification** | See section 0 | See section 0 |
| PRED - Product specification edition number | 1.0 | 1.0 |
| **PROF - Application profile identification** | See section 0 | See section 0 |
| DSSI - Dataset Structure Information field | | |
| DSTR - Data structure | {2} - chain node | {2} - chain node |
| AALL - ATTF lexical level | {0} or {1} | {0} or {1} |
| NALL - NATF lexical level | {0} to {2} | {0} to {2} |
| NOCR - number of cartographic records | {0} | {0} |
| NOFA - number of face records | {0} | {0} |
| DSPM - Dataset Parameter field | | |
| HDAT - Horizontal geodetic datum | {2} - WGS84 |  |
| DUNI - Units of depth measurement | {1} - metres |  |
| HUNI - Units of height measurement | {1} – metres |  |
| PUNI - Units of positional accuracy | {1} - metres |  |
| COUN - Coordinate units | {1} - lat./lon. |  |
| SOMF - 3-D (sounding) multiplication factor | {10} |  |

Table 3 – AML S-57 Sub-field values

## 6.3 AML S-57 Sub-field VARIANCES

### 

AML Product Specifications modify the ENC S-57 implementation of Data Set header records to reflect differences in the intended usage, product specifications, and application profiles.

In order to meet stated requirements for AML products, the following variations from the ENC implementation of S-57 will be necessary. A summary of these amendments is given below.

### 6.3.1 Data Set Identification Field

These changes affect the following subfields within the Data Set Identification Field (DSID):

* INTU
* PRSP
* PROF

#### 6.3.1.1 Intended Usage Sub-Field (INTU)

Values that AML will use in these sub-fields will be specified in individual AML Product Specifications. However, data may be compiled and made available at the scale bands shown in Table 4:

|  |  |  |
| --- | --- | --- |
| **Scale Band** | **Data Compilation Scale** | **Display Scale Range** |
| 0 | Unscaled | Unscaled |
| 1 | < 1:100,000,000 | < 1:40,000,000 |
| 2 | 1: 25,000,000 | 1: 10,000,000 -- 1:62,500,000 |
| 3 | 1: 5,000,000 | 1: 2,000,000 -- 1:12,500,000 |
| 4 | 1: 1,000,000 | 1:400,000 -- 1: 2,500,000 |
| 5 | 1:250,000 | 1:100,000 -- 1:625,000 |
| 6 | 1:50,000 | 1:20,000 -- 1:125,000 |
| 7 | 1:10,000 | 1:4,000 -- 1:25,000 |
| 8 | 1:2,500 | 1:1,000 -- 1:6,250 |
| 9 | > 1:1,600 | > 1:1,500 |

#### Table 4 – AML Scale bands and scale values

#### 6.3.1.2 Product Specification Sub-Field (PRSP)

This will be used to denote the appropriate AML Product Specification. Values for the individual AML Product Specifications for use in the PRSP sub-field are given in Table 5:

|  |  |  |
| --- | --- | --- |
| **PRSP No.** | **AML Product Specifications** | **Acronyms** |
| 51 | Maritime Foundation and Facilities | MFF |
| 52 | Routes, Areas, and Limits | RAL |
| 53 | Large Bottom Objects | LBO |
| 54 | Contour Line Bathymetry | CLB |
| 55 | Environment, Seabed and Beach | ESB |
| 56 | Small Bottom Objects | SBO |

Table 5 – Product Specification Sub-Field values

#### 6.3.1.3 Application Profile Sub-field (PROF)

Table 6 lists the mnemonics and associated binary values AML employs for the PROF subfield:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Product Specification** | **Base Cell File** | | **Update Cell File** | |
| **ASCII** | **BINARY** | **ASCII** | **BINARY** |
| CLB | CN | 4 | CR | 5 |
| ESB | EN | 6 | ER | 7 |
| LBO | LN | 10 | LR | 11 |
| MFF | MN | 12 | MR | 13 |
| RAL | RN | 16 | RR | 17 |
| SBO | SN | 18 | SR | 19 |

Table 6 – Application profile sub field

#### 6.3.2 Comment Sub-field (COMT)

AML uses this sub field to hold the ‘text string’ information below:

* IDO Status
* Protective Marking
* Owner Authority
* Caveat

To encode multiple values (as specified above), each of the values are separated by a semi-colon. An example is provided below;

IDO Status = NATO; Protective Marking = Restricted; Owner Authority = UK

System implementations should use these values. For example, chart-like titles may be used to support chart catalogues and searching; protective marking should be displayed prominently when a cell is loaded into the display.

**6.3.3 Vector records**

The following vector record fields are only used in specific AML products. These are listed in Table 7. All fields are used in AML 3.0 due to the different structure of that product specification.

|  |  |
| --- | --- |
| **Field** | **Product** |
| Arc/Curve Definition Field Structure - ARCC | RAL |
| Arc Coordinates Field Structure - AR2D | RAL |
| 3-D Coordinate (Sounding Array) Field Structure - SG3D | CLB |

Table 7 – Vector records used in specification AML Product Specifications

**6.3.4 Feature records**

For all AML products the Feature Record Identifier Field (FRID) is fixed to the value 255 = (null) in the GRUP subfield. This reflects that AML products do not use the group 1 and 2 objects as done within ENC to distinguish skin of the earth objects.

**7 FEATURE CATALOGUES**

For each vector AML Product Specification version there are corresponding Object and Attribute Catalogues. These list all objects and attributes which can be used within those products and list the relevant S-57 codes. However guidance in the product specification may override the Object and Attribute Catalogue content.

* AML 1.0 [Object and Attribute O&A Catalogue, Version 1, v1.1.6](http://www.ukho.gov.uk/Defence/AML/Documents/Item%2065%20AML%20OandA%20LIST%20v1.1.6.xls)
* AML 2.1 [Object and Attribute O & A Catalogue version 2 & 2.1, v2.3.3](http://www.ukho.gov.uk/Defence/AML/Documents/Item%2066%20OandA%20LIST%20v2.3.3.xls)
* AML 3.0 [AML Feature and Attribute Catalogue v3.0.1](http://www.ukho.gov.uk/Defence/AML/Documents/Item%2032%20AML%20Feature%20and%20Attribute%20Catalogue%20v3.0.1.xls)

These catalogues are available to download from the AML web pages of the UKHO website.

**8 PORTRAYAL**

For many years no published display specifications for AML existed. It was envisioned that AML would have different displays for specific applications. However, experience has shown that although specific displays may exist, a common or default display specification was required. Therefore the GMWG set about developing an AML Portrayal Specification which was first published in February 2016. It is aimed primarily at WECDIS systems and provided as a S-52 .DAI file. However this does not prohibit implementation of the specification in other systems including web services.

The AML Portrayal Specification defines symbols and rules for the display of vector AML datasets and supports AML 1.0, 2.1 and 3.0 vector products. It builds on the IHO S-52 Edition 6.1 standard and the Presentation library 4.0.

Additional symbols have been added where required, and additional viewing groups created to allow users to customize the display to meet their needs.

The priority for symbol sources was;

1. S-52
2. Geosym (MIL-89045A)
3. MIL-STD-2525C resp. APP-06(C)
4. Other sources / own creation

No additional Conditional Symbology Procedures as defined in S-52 are included although those in the S-52 Preslib 4.0 are referenced.

Unlike ENC display no simplified symbology is included. Generally colours have been used as follows within the specification;

* 1. Environmental: green
  2. Operational: red
  3. Air: blue
  4. Seabed: brown

Where appropriate other symbology specifications have been used as the source for symbols and rules. These include IHO S-411, NATO APP-6, MIL STD 2525 and MIL DTL 89045A.

The specification is documented as a .dai file which contains the look up tables and symbols. In addition an Excel spreadsheet provides a human readable version of the specification. A number of additional viewing groups have been used beyond those defined in S-52 and these are also listed within the Excel spreadsheet and should be implemented in software using the names shown.

The specification carries no security markings.

**8.1 Testing**

Due to its basis in S-52 the IHO Test Datasets for ECDIS S-64 Edition 3.0.1 provides a means to test S-52 display and therefore systems which pass these tests should support this specification. A specific test standard may be developed to accompany this specification in the future. Existing AML test data available on the UKHO website may also be useful for testing purposes.

**8.2 Maintenance**

GMWG welcome feedback on this specification and further versions will be prepared to reflect feedback received and to enhance the specification. This may also include extending this specification to cater for gridded AML data products.

Enquiries or requests for the specification should be directed to the following email address; <mailto:customerservices@ukho.gov.uk>

**9. TEST DATA**

AML test data is provided on the AML web pages hosted on the UKHO website [LINK](http://www.ukho.gov.uk/Defence/AML/Pages/Home.aspx). It has been produced to support system development and testing. It is intended to provide representative coverage of the AML data model. To achieve this it contains examples of each object type with at least one example with fully populated attribute values.

**9.1 Vector Product Specifications**

* AML 1.0 datasets are provided as a set of S-57 base files covering the area of BA Chart 2045. These include a number of additional support files. For the CLB and RAL cells two new editions are also provided. The LBO, ESB and MFF cells also have updates provided.

* AML 2.1 – no specific test data is currently available.
* AML 3.0 – a set of AML 3.0 trials data has been produced by the German Bundeswehr. This covers the following content:
  + Land charts (LND) in different scale bands - derived from various sources as Continental data, VMap1, high resolution land survey data.
  + Bathymetric charts (CLB) in different scale bands -derived from the sea survey data base of the German Hydrographic Office.
  + Flight Aeronautical Information (FAI) - derived from NGA AVDAFIF.
  + Military Flight Information (MFI) - derived from NGA AVDAFIF.
  + Nautical chart background data (NCD) - derived from various German ENCs.
  + Q-Route (QRT), Sediment data - derived from the German Mine Warfare data centre.
  + One SBO cell containing fictitious data.
  + One LBO cell containing fictitious data.

**9.2 Gridded Product Specifications**

* AMC – no test data is currently available.
* IWC – test data for Component 1 (Physical Climatology) and Component 2 (Marine Mammals) is available.

**ANNEX A – GLOSSARY**

|  |  |
| --- | --- |
| AMC | Atmospheric and Meteorological Climatology |
| AML | Additional Military Layers |
| CLB | Contour Line Bathymetry |
| ECDIS | Electronic Display and Information System |
| ENC | Electronic Navigational Chart |
| ESB | Environment, Seabed and Beach |
| GS ESB | Gridded Sediment Environment Seabed and Beach |
| IHO | International Hydrographic Organization |
| IWC | Integrated Water Column |
| LBO | Large Bottom Objects |
| MFF | Maritime Foundation and Facilities |
| NetCDF | Network Common Data Form |
| RAL | Routes, Areas and Limits |
| SBO | Small Bottom Objects |
| STANAG | Standardization Agreement (NATO) |
| TDA | Tactical Decision Aids |
| UKHO | United Kingdom Hydrographic Office |
| WECDIS | Warship Electronic Display and Information System |