GENERIC SENSOR FORMAT SPECIFICATION

12 December 2024

Prepared For:

Naval Oceanographic Office

Stennis Space Center, MS 39522

Prepared By:

Leidos Corporation

221 Third Street

Newport, RI 02840

Table of Contents

TABLES

FIGURES

REVISIONS			
Rev	**Date**	**Pages Affected**	**Remarks**
0	30 SEP 93	All	Initial Draft Version.
A	31 MAR 94	All	Final Draft Version.
B	30 JAN 95	All	Released as Draft MIL-STD-2415
C	29 JUL 96	All	Sequential encapsulation updated to reflect changes due to implementation of software version GSF-v1.02.
D	04 SEP 98	All	No longer designated as Draft. Changes as follows: • Updated specification to reflect changes due to implementations through GSF-v1.06. • Removed the direct access encapsulation (GSF/DA) from the specification, leaving only the sequential encapsulation. • Restricted all time fields in a data file to use precise time. All data currently conforms to this restriction. This change in effect codifies a restriction imposed by the use of the library as part of the standard. • Reformatted the document into Word 6.0(95) format. Updated all figures into Windows metafile format (WMF). • Limited editing resulting in spelling, grammatical and a few technical changes. • Changed the header numbering sequence from 1.1.1.a (1) to 1.1.1.1.1.

			• Split table 2 (GSF/S Record Definitions) into a separate table for each record. Added references for POSIX 1003.1 and GSF Library documentation.
E	12 NOV 98	All	Changes as follows: • Updated specification to reflect changes due to implementations through GSF-v1.07. • Modified the gsfPrintError function to call the gsfStringError function. • Defined a new GSF navigation error record that replaces the currently defined navigation error record. • Defined a new horizontal navigation error record that contains a text field describing the positioning system type. • Modified gsf_enc.c to encode the existing error array subrecords (depth_error, across_track_error and along_track_error) as two byte quantities. • Added two new array subrecords, horizontal error and vertical error, to the GSF swath bathymetry ping data structure,
F	07 OCT 99	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v1.08. • Updated the description of the beam angle forward array and the beam angle array subrecords. • Updated Appendix A.2 Swath Bathymetry Ping Subrecord Identifier Definition to reflect additions of EM3000_SPECIFIC, EM1002_SPECIFIC, EM300_SPECIFIC and CMP_SASS_SPECIFIC subrecord identifiers

			• Added Swath Bathymetry Ping Sensor-specific Subrecord Definitions for the SIMRAD EM3000 series sonar, Compressed SASS data, and TypeIII SASS data
G	12 OCT 99	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v1.09. • Modified Swath Bathymetry Ping Sensor-specific Subrecord Definition for the Compressed SASS data format.
H	20 OCT 00	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v1.10.
I	16 JAN 01	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v1.11.
J	03 APR 02	A-3	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.0. Reserved sensor specific subrecord IDs for Reson 81P series 8101, 8111, 8125, 8150, and 8160 sonar systems. Added sensor specific subrecord ID and subrecord definition for Simrad EM120
K	08 JUL 02	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.01.
L	20 JUN 03	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.02, including updates for multibeam imagery per bathymetric receive beam

M	29 DEC 04	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.03.
N	30 JUN 06	All	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.04.
O	09 MAR 07	Various	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.05.
P	04 SEP 07	Various	Changes as follows: • Updated specifications to reflect changes due to implementations through GSF-v2.07.
Q	04 Dec 07	None	No changes to the text for GSFv2.08
R	30 Jan 08	Various	Changes as follows: • Added Swath Bathymetry Ping Subrecord Identifier for Klein 5410 Bathymetric Sidescan. • Added Swath Bathymetry Ping Subrecord for Klein 5410 Bathymetric Sidescan. • Added Bathymetric Receive Beam Imagery Sensor-specific Subrecord for Klein 5410 Bathymetric Sidescan.
S	20 Mar 09	Various	Changes as follows: • Added EM2000 to EM3 supported sensors • Added specifications for Reson7100 specific data • Added specifications for EM3 specific data recorded with raw range and beam angles • Updated specifications to reflect changes due to implementations through GSF-v3.01

T	24 Sep 10	Various	Changes as follows: • Added support for Kongsberg EM2040 • Added support for Imagenex Delta-T • Expanded processing parameter record to include additional offsets • Expanded Navigation Uncertainty record to include field for separation uncertainty • New functions added to return information about contents of GSF file and supportable operations
U	24 Sep 11	Various	Changes as follows: • Added support for Kongsberg EM12 • Added support for R2Sonic
V	8 June 12	None	
W	02 May 14	Various	GSFv03.05 Changes as follows: • Added support for sonar vertical uncertainty • Additional processing parameter values defined
X	30 Jun 2014	Various	• No changes to the text for GSFv03.06
Y	31 Oct 2016	Footers	• Updated the version and build date
Z	2 Oct 2018	Various	• Added support for Reson T Series multibeam sonars
AA	26 April 2019	Various	GSFv03.09 Changes follow: • Added support for Kongsberg Multibeam sonars using the KMALL format. • Added functionality for storing GSF compressed.
AB	12 April 2024	Various	GSFv03.10 Changes follow:

			• Added support for Simrad ME70 • STIG remediation to address vulnerabilities • Updates to KMALL ping-level metadata to support backscatter processing • Updates to bathymetry ping structure to support TVG DB • Range of bug fixes
AC	12 December 2024	Various	GSFv03.11 Changes follow: • Fixed bug regarding beam_angle_forward signage • Fixed bug where start_range_samples wasn’t being copied in gsfCopy

1. INTRODUCTION

1.1 Purpose

This report documents a Generic Sensor Format (GSF) for use as an exchange format in the Department of Defense Bathymetric Library (DoDBL), one of three DoDBL processing formats. Similar formats are under development for the interchange of vector data, such as hydrographic soundings and features; and raster data, such as gridded bathymetry and processed acoustic imagery.

This standard focuses on the encoding of multibeam data, the highest priority for the DoDBL; single-beam data is included as well. It is also designed to be expandable to encode unprocessed acoustic imagery as those Defense Hydrographic Initiative (DHI) requirements become clearer. It is intended for coordination among the DoDBL nodes - the Defense Mapping Agency (DMA), the Naval Oceanographic Office (NAVOCEANO), the National Ocean Service (NOS), and the National Geophysical Data Center (NGDC), as well as academia and industry to collect data and design systems that use GSF.

1.2 Background

GSF is designed to efficiently store and exchange information produced by geophysical measurement systems before it has been processed into either vector or raster form. A sensor data set contains all the information needed to compute the depth or other values at a specific geographic position, but that calculation has not yet been made. This structure is particularly useful for data sets created by systems such as multibeam echosounders that collect a large quantity of data from a single location and initially express geographic positions in relative terms. GSF not only saves storage space and reduces data transfer volumes, it also provides the receiver with critical information that may be lost when processing the oversampled data to either raster or vector form.

The current use of GSF is to define data from bathymetric and imagery surveying systems; however, this is only one of a class of sensors that GSF can support. Acoustic imagery, seismic reflection profiles, swept-frequency (chirp) sub-bottom imagery are other classes of data that may be incorporated into the DoDBL but cannot be efficiently stored in either vector or raster form.

This draft standard implementation was based on earlier work at the University of Rhode Island supported by DHI and other work at the Naval Research Laboratory (NRL). This paper does not present the rationale for this implementation. The rationale is based on two earlier papers, which describe the overall rationale and approach (Ferguson and Chayes, 1992 and 1995) and on extensive discussions with Mssrs. deMoustier and Charters at Scripps Institute of Oceanography.

1.3 DoDBL overview

The DoDBL is a distributed library of bathymetric and hydrographic data (note: the Hydrographic Source Assessment System (HYSAS) documentation uses these terms interchangeably). The data, which are acquired and archived by organizations in the Department of Defense (DoD) and the Department of Commerce National Oceanic and Atmospheric Administration (NOAA), may be stored in many different structures and formats. The intent of this specification is to ease data exchange among the nodes by standardizing the format for sensor data files, including unprocessed bathymetry and acoustic imagery. The two other general types of data in the DoDBL: vector (which includes single-beam soundings) and raster (which includes gridded bathymetry and rectified acoustic imagery) use similar specifications. GSF is also intended for data transfer between collection platforms and their respective DoDBL node.

There are many sources for DoDBL data sets. The GSF deals primarily with multibeam (swath) and acoustic imagery data sets that are collected by both DoD and non-DoD survey vehicles.

1.3.1 Usage of GSF outside of DoDBL

This specification describes the form of data being exchanged within the DoDBL. The format described in this specification is intended, however, to be of use outside the DoDBL. Using this format will increase the efficiency of data transfer between the agency's internal archive and the DoDBL and, perhaps, between agencies without direct access to the DoDBL. For use of this specification outside the DoDBL, Transmittal files and Metadata files are optional, although their use is encouraged. Many of the elements of the Metadata file may be most accurately described immediately after the data have been collected. From the moment the data are collected, adoption of the Metadata file as a method of maintaining important descriptive information can significantly enhance the data's long-term usability.

1.4 Goals

GSF is designed to be modular and adaptable to meet the unique requirements of a variety of sensors. The goals of the Generic Sensor Format are:

- Portability among all major computing platforms.
- Extensibility so that new types of data and measurements can be easily incorporated.

- Efficiency in terms of storage volume and data access.
- Endorsement by the major groups of users *outside* the DoDBL.
- Consistency with other DoDBL formats.

1.4.1 Portability

Portability among the various computing platforms that will collect, process, and store data in GSF is critical. Adequate data description and the exclusive use of industry, national and international standards for data encoding ensure portability in this standard. Where practical, GSF is consistent with industry standards for network exchange. This will reduce the time for some systems once the DoDBL nodes are fully networked.

1.4.2 Extensibility

Because of the rapid state of development in sensor systems, it is very important to provide a mechanism for planned growth and evolution. Increasing sophistication of the sensor systems and signal processing techniques have increased the information extracted from a single ping. It is essential that GSF allow for expansion to prevent early obsolescence of the format. GSF achieves extensibility through modular structure and self-description.

New data elements can be specified for new data records and these records can be introduced into a data stream without forcing all programs that may read them to be modified. These features taken together allow different network implementations to coexist on the same data path and are partly responsible for the popularity and success of the Ethernet transport protocol. By adopting a similar approach, GSF has been equipped with a mechanism for gradual change that should help ensure its long-term usefulness.

1.4.3 Efficiency

To enhance storage efficiency, GSF makes extensive use of binary encoding. Most data elements within GSF are numeric, and it is estimated that the use of standard binary 2- and 4-byte big endian (most significant byte first) integers reduces storage volume by 40-50%. The self-defining header schema and time-tagged records allow efficient data access.

1.4.4 Acceptance

The development of this specification incorporated inputs from many different segments of the swath mapping community. Representatives of commercial, academic and federal agencies all provided valuable feedback during the definition of this specification.

1.4.5 Consistency

This standard is consistent with the other standards to be used in the DoDBL. It has a common Transmittal Header File to allow rapid identification by the receiver, and common Metadata elements to provide the standard DHI ancillary information about the data set. It also uses big endian binary like the proposed Raster Data Exchange Standard (RDES) to obviate the need to develop unique utilities.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications, standards, and handbooks

The following specifications, standards, and handbooks form a part of this document to the extent listed below. Unless otherwise specified, the issues of these documents are those listed in the current Department of Defense Index of Specifications and Standards (DODISS) and the supplement thereto.

MILITARY STANDARDS

MIL-STD-490A	Specification Practices
MIL-STD-600001	Mapping Charting & Geodesy Accuracy Standard, 26 February 1990
MIL-STD-600003	MC&G Product Generation Rules

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications

The following Government documents, drawings, and publications form a part of this document to the extent specified. Unless otherwise listed, the document versions are those cited in the solicitation.

DMA TM 8358.1	Datums, Ellipsoids, Grids, and Grid Reference Systems. First Edition. September 1990
DIAM 65-18	Defense Intelligence Agency Manual - Geopolitical Data Elements and Related Features. March 1984

(These publications are available from DMA by writing to: Director, Defense Mapping Agency, ATTN: PR, 8613 Lee Highway, Fairfax, VA 22031-2137.)

2.2 Non-Government publications

The following publications form a part of this document to the extent specified. Unless otherwise noted, the issues of the documents that are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. The issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

ANSI/IEEE 754-1985. IEEE Standard for Binary Floating Point Arithmetic. August 12, 1985. (Application for copies should be addressed to the publisher: IEEE, Inc., 345 East 47th St., NY, 10017)

ANSI/IEEE Std 1003.1b-1993. IEEE Standard for Information Technology – Portable Operating System Interface (POSIX) – Part 1: System Application Program Interface (API) – Amendment 1: Realtime Extension [C Language]. (Application for copies should be addressed to the publisher: IEEE, Inc., 345 East 47th St., NY, 10017)

ANSI x3.4-1977. Code for Information Interchange (ASCII) Adopted in FIPSPUB 1-1, 24 December 1980.

ISO 8601. International Organization for Standardization, Data Elements and Interchange Formats - Information Interchange - Representation of Dates and Times, 1988 (Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018).

Bureau of the Budget, United States National Map Accuracy Standards, Government Printing Office, 1947. (This standard is printed in its entirety in Thompson, Morris M., 1988, Maps for America, U.S. Geological Survey, 3rd ed., p. 104).

Chayes, D.A., Nishimura, C.E., Czarneki, M.F., Pitcher, D. 1991. A Paradigm for Processing Sidescan and Bathymetry: The Next Generation. Proceedings of the Maritime Technical Society.

Ferguson, J.S. and Chayes, D.A. 1992. A Generic Swath-Mapping Data Format. Marine Geodesy vol. 15, pp 129-140

Ferguson, J.S. and Chayes, D.A. 1995. Use of a Generic Sensor Format to Store Multibeam Data. Marine Geodesy vol. 18, pp 299-315

GSFlib, the Generic Sensor Format Library, 16 January 2001.

Non-government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other information services.

2.3 Order of precedence

If there is a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. CONVENTIONS

3.1 Accuracy

Data files exchanged using the GSF may be of any accuracy. However, the horizontal and vertical accuracy must be determined by standard method and cited in the Metadata File or supporting documentation.

3.2 Datums

The preferred horizontal datum is the World Geodetic System 1984 (WGS-84) ellipsoid. However, data files exchanged using the GSF may be referenced to any datum as long as the datum is cited in the Metadata File or supporting documentation

The preferred vertical (sounding) datum is the WGS-84 geoid. However, data files exchanged using the GSF may be referenced to any datum as long as the datum is cited in the Metadata File or supporting documentation. All depths shall be referenced as positive displacements below datum; e.g., a depth of 100 meters below datum would be represented as 100.

3.3 Swath-related nomenclature

Two methods of determining beam location relative to a vessel are allowed by GSF, as illustrated by Figure 3-1. Most multibeam sonars provide data in a mixture of both systems. The first is a polar coordinate system with the vessel at the center of a sphere. Individual soundings are located by measuring the range from the vessel to the bottom and the beam angle. The pitch angle is also required and is usually constant for a given ping.

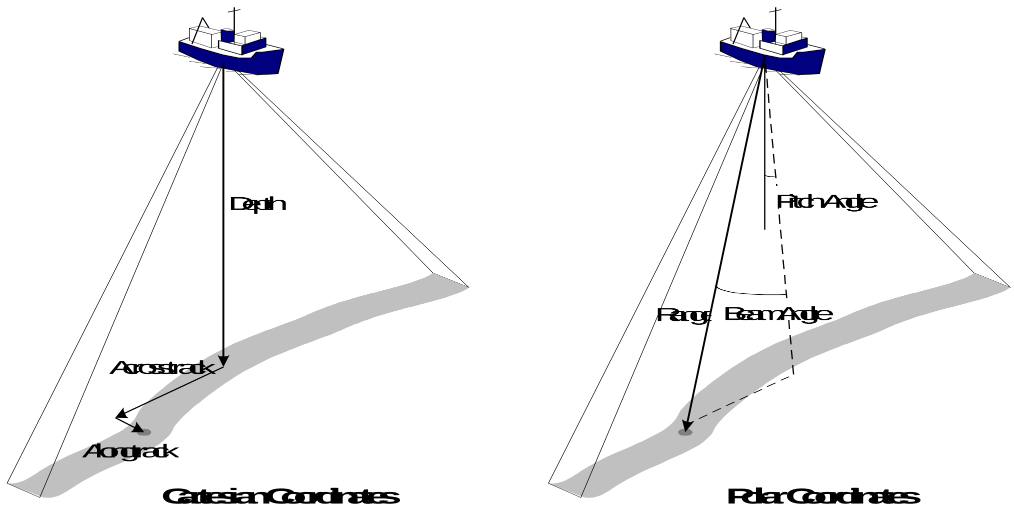

Figure 3-1 Coordinate systems for beam location

GSF also supports a Cartesian system in which individual soundings are located by describing their depth, acrosstrack and alongtrack offsets. Alongtrack offsets may be expressed for each ping or each beam, as appropriate to the specific system, and may be encoded as a distance or a pitch angle.

3.4 Ship-based coordinate system

Figure 3-2 shows the ship-based coordinate system used to refer to both onboard locations of sensors and their ship-based measurements. The vessel's direction of travel is along the x-axis. The z-axis is positive down to be consistent with the convention that depths are expressed as positive numbers. The y-axis is defined to point to starboard in order to form a right-handed coordinate system and is consistent with the usual convention that beam offsets increase in the positive direction. The origin of the coordinate system is arbitrarily located on the vessel, either at the center of the sonar's transducer array or at the vessel's center of motion, as appropriate.

Depths are positive and increase as one moves below the ocean's surface, acrosstrack offsets are positive to the vessel's starboard and negative to port, and alongtrack offsets are positive forward of the vessel's reference position and negative astern of it. Heave is positive if the vessel moves below the mean or reference surface.

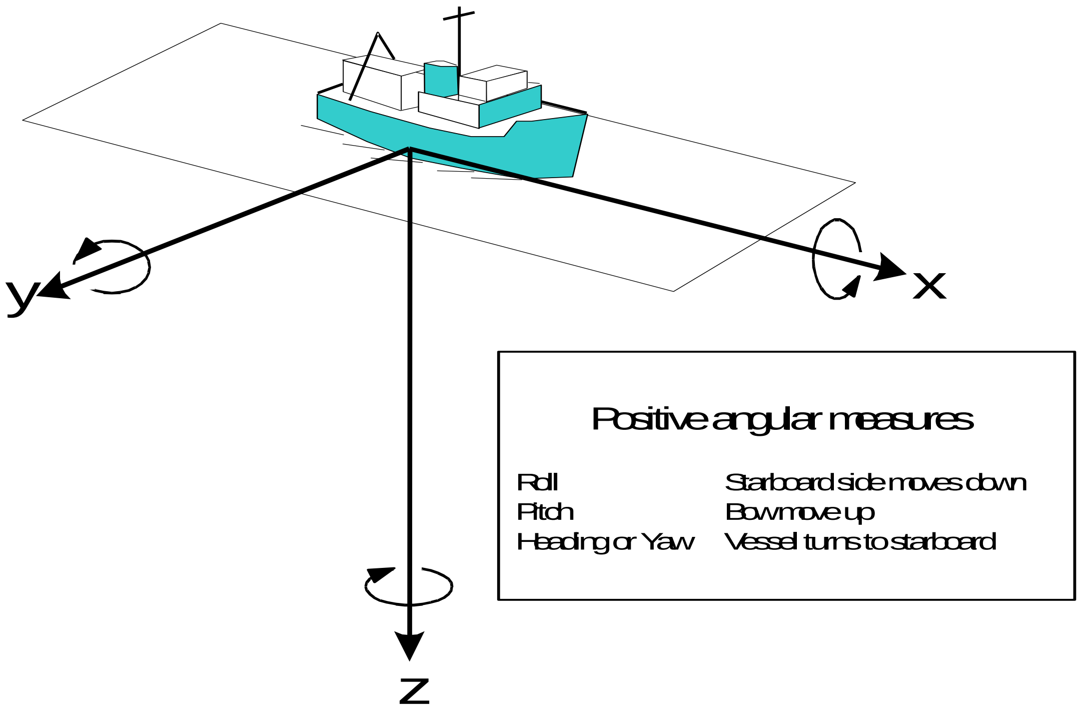

Figure 3-2 Ship-based coordinate system

3.5 Units of measure

Units of measurement in this specification are metric and are the preferred units of measurement for GSF files. However, data from systems that use English units may be recorded as such, so long as these units are properly documented.

3.6 Data element formats

3.6.1 Text

Text shall be standard ASCII characters as defined by ANSI x3.4-1977. Text fields shall normally be fixed-length, but Comments fields are variable-length. Text fields are left justified and are signified in this specification by a "T".

3.6.2 Binary integers

To reduce storage volume, GSF makes extensive use of binary integers. All integers shall be big endian (most significant byte first), and may be either 1-byte unsigned, 2-byte signed or unsigned, or 4-byte signed, as required and as specified in the file header. An “I” shall identify signed binary integers in this specification; a “U” shall identify unsigned integers.

GSF may make use of binary integer arrays. When specifying the length of the array, the format is <integer length>*<number of integers>. For example, a field type of "I" and a count of "2*3" indicate a 2-byte integer array with three elements. GSF often encodes several integers within one 32-bit word. The structure of these packed words is fully defined in this specification.

3.6.3 Geographic coordinates

Horizontal position coordinates may be encoded either as a special case of the text field or binary integer field.

3.6.3.1 Text form

Position in text form shall normally be used in high-level GSF files such as the Metadata file and shall be specified in the format:

±DDDMMmmmm±DDMMmmmm,

where D=degrees, M=minutes and m=.0001 minutes, the first set of values specifies the longitude (+ is East), and the second set of values specifies the latitude (+ is North)

For example, -075300000+45160020 would be 45°16.002'N 75°30'W.

3.6.3.2 Binary form

To maintain consistency with the rest of the file and reduce storage volume, the GSF data files use position in binary form. Latitude and longitude are encoded using two 4-byte signed integer fields representing ten-millionths of degrees. Latitude is positive in the Northern Hemisphere and longitude is positive in the Eastern Hemisphere.

For example,	latitude = 325000000	longitude = -0702550000,
would be	32.5°N (32°30'N)	70.255°W (70°15'18”W).

3.6.4 Depths

Normally, depth measurements shall be in meters or decimeters. Some multibeam systems consistently calculate depths according to the English measurement system, recording them in fathoms. These units are acceptable if properly documented. In all cases, it is imperative to explicitly state the assumptions used to derive these values. For example, depths reported in meters may assume a constant sound velocity of 1500 meters/second to derive the depths. This fact must be properly recorded in the SOUND_VELOCITY field of the metadata file.

3.6.5 Dates

Date fields shall conform to ISO 8601, paragraph 5.2.1.1 (Basic Format), and shall be of the form CCYYMMDD (e.g., 19920831 for August 31, 1992). A "D" shall identify date fields in this specification.   Such fields are usually limited to transmittal and metadata files.

3.6.6 Times

The representation of time within the GSF is an important design element. Because time appears in many places within a GSF data set, it can have a significant impact on data volume. In transmittal and metadata files, ISO 8601 defines standards for representation of dates. In the data files, ISO 8601 is not appropriate because the standard only allows character representations. It would expand data volume by an unacceptable amount.

The POSIX System Application Program Interface standard controls representation of Time in GSF data files. This includes real-time extensions and uses a combination of three values: a reference time, the number of seconds that have elapsed since the reference point, and the number of nanoseconds that have elapsed since the beginning of the current second. The reference time is specified as midnight on 01 January 1970 Universal Time Coordinated (UTC). Data collected prior to 1970 may be handled with a reference time earlier then 01 January, 1970. A 4–byte integer field specifies the number of elapsed seconds since the reference time. A second 4-byte integer field specifies the number of elapsed nanoseconds since the beginning of the current second. All time values in GSF are required to be relative to UTC.

3.6.7 Angular measures

Angular measures such as heading, course, yaw, roll and pitch are represented in hundredths of degrees and are stored as 2-byte signed or unsigned integers.

3.6.7.1 Heading and course

Heading refers to the direction of the vessel's bow and course refers to the direction of its motion through the water. Heading and course are measured from true North, and describe the vessel's rotation about the z-axis. They increase in value as the vessel turns to starboard in accordance with standard compass angular measures and have a range of 0.00 to 360.00 using a 2-byte unsigned integer.

3.6.7.2 Yaw

The vessel's short-term rotation about the z-axis is the Yaw. It is measured from the bow of the ship and increases toward the starboard side of the vessel. Yaw normally describes short-term oscillation or pointing errors due to gyrocompass or transducer array misalignment. Yaw has a valid range of –180.00 to +180.00 using a 2-byte signed integer.

3.6.7.3 Roll

Roll describes the vessel's rotation about the x-axis. Roll is measured from references established when the vertical reference sensor system is calibrated and should be near zero when the ship is evenly trimmed. Roll increases in value as the ship's starboard side moves downward and has a valid range of -180.00 to +180.00 using a 2–byte signed integer.

3.6.7.4 Pitch

Pitch describes a ship's rotation about the y-axis. Like roll, pitch is measured from references established when the vertical reference sensor system is calibrated and should be near zero when the ship is evenly trimmed. Pitch increases as the sensor platform moves upward and has a valid range of -180.00 to +180.00 using a 2-byte signed integer.

3.7 Record Description

Each record is composed of a set of fields that contain the data elements that are defined in subsequent tables. Fields may be big-endian binary (most significant byte first) or ASCII and may be fixed- or variable-length. This specification presents GSF records in tabular form. Figure 3-3 describes the conventions used in these tables.

Items in ***Bold Italics*** are the labels for the header

Field Name	***Field Description***	***Field Type***	***Count***
RECORD_POSITION	Position of record in file, in bytes	I	4
RECORD_LENGTH	Length of record, in bytes	I	4

Name for each field in the file, as specified in the file header

Description for each field in the file, as specified in the header. Items in **Bold** (not shown) are common to all DoDBL raster data sets and specify the actual field entry.

Field Type and Count for each field in the file, as specified in the header.

Figure 3-3 GSF definition conventions

4. DATA STRUCTURE

Data stored in Generic Sensor form are contained in several files, each with a specific use. A complete GSF data set contains all these files, related as shown in Figure 4-4. These files are:

- Transmittal files that describe what data are being transmitted in a given transaction and how they may be handled,
- Metadata Files that describe the contents and nature of a given collection of data, and
- Files containing the data themselves.

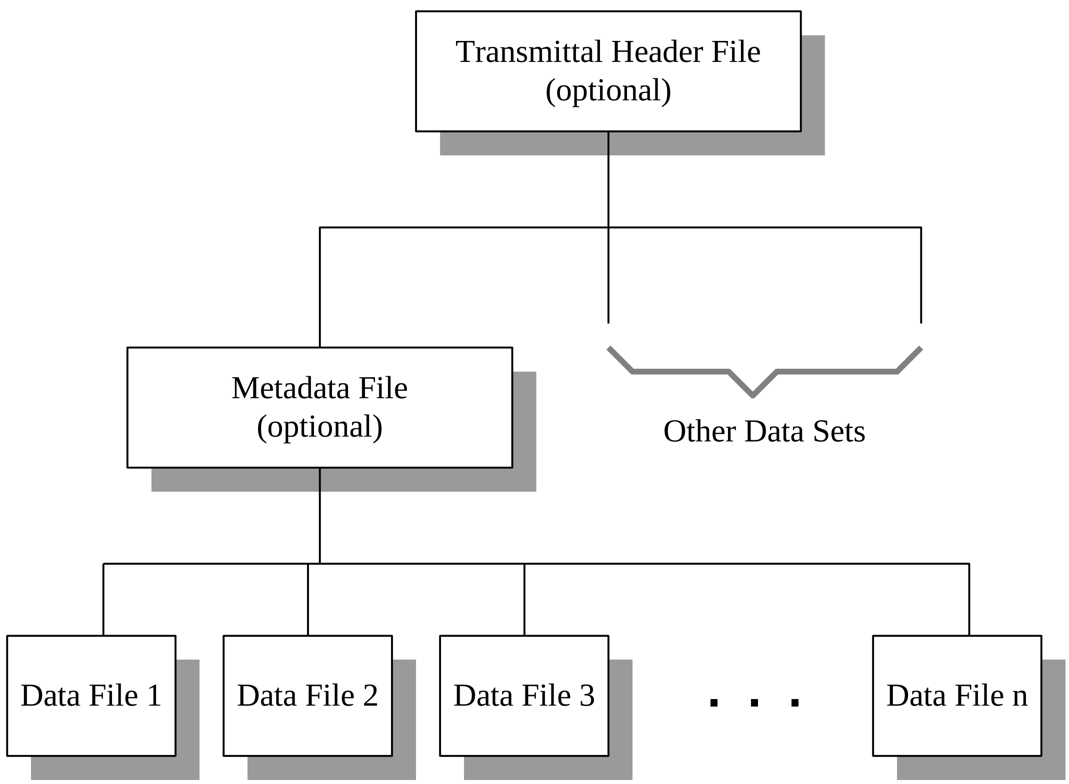

Figure 4-4 Data Set Organization

Transmittal files are developed to describe a particular transaction. Transmittal files are not a permanent record that describes the data, but record the transfer of data, document the prescribed handling, the format of the media and the specifications that describe the data's form.

Metadata files describe the data themselves, including their temporal and areal extent, and the overall condition of a GSF data set.

GSF data files are organized by time; data collected over a given time period shall be stored in a single file. All the data collected from a given sensor over a period of time is recorded in a single file. The amount of data recorded in a given sequential file may be fixed (e.g., data may be segregated by date of collection) or may be based on operational requirements such as survey layout. A GSF data set may be composed of one or more GSF data files. Data sets will generally be segregated based on operational or logistical factors such as survey area or cruise duration. A single metadata file describes the contents of the entire data set.

4.1 Transmittal Header File

This file, common to all DoDBL exchange sets, provides information on the type of data to be exchanged, the number of data sets in the exchange, the highest security classification, and the standards and specifications used for this transmittal. It can be printed and provided in hardcopy when the transmittal is by physical (not network) exchange. If the transmittal spans more than one volume, then each volume shall have a Transmittal Header File. The use of the Transmittal Header File is mandatory for exchanges within the DoDBL but is optional for data exchanged outside of the DoDBL. Table 4-1 specifies the contents of the Transmittal Header File.

Table 4-1 Transmittal Header File

Field Name	*Field Description*	*Field Type*	*Count*
VERSION	Version Number (reserved)	T	10
DATA_NAME	**DoDBL Sensor**	T	12
DATA_DESCRIPTION	General description of data	T	100
MEDIA_STD	Media standard used on this volume. E.g., ISO 9660	T	20
ORIGINATOR	Sender, e.g., DMAHTC	T	50
ADDRESSEE	Receiver with address	T	120

MEDIA_VOLUMES	Number of volumes in this transmittal	T	2
SEQ_NUMBER	Sequential order of this volume	T	2
NUM_DATA_SETS	Number of data sets in this transmittal	T	2
SECURITY_CLASS	Highest classification on this volume (See HRD)	T	1
DOWNGRADING	Originating Activity Determination Required (OADR)? **YES** or **NO**	T	3
DOWNGRADE_DATE	Date of downgrading, blank if OADR	D	1
RELEASABILITY	Releasability restrictions	T	20
OTHER_STD_NAME	**Generic Sensor Format**	T	50
OTHER_STD_DATE	Publication date of GSF	D	1
OTHER_STD_VER	Version of GSF	T	10
TRANSMITTAL_ID	Unique ID for this transmittal	T	12
EDITION_NUMBER	Edition number for this database	T	10
EDITION_DATE	Date of creation for this database	D	1

4.2 Metadata File

This file, also contained within all DoDBL exchange sets, provides information on the computed quality, the parameters used to compute quality, the areal extent, and the security classification of each individual data set. There is one Metadata File for each data set in the transmittal. It is permissible to forward a hardcopy listing of the information contained in the Metadata File as long as the information is complete and accurate. The use of the Metadata File is mandatory for exchanges within the DoDBL; it is optional for exchanges that do not occur within the DoDBL mechanism. Its use is strongly encouraged, however, to assure uniform maintenance of important descriptive data. The HYSAS Requirements Document (HRD) specifies the contents of the Metadata File.

4.3 GSF Data File

GSF data files are composed of a series of records arranged sequentially in time. A header record is the first record in the file; otherwise, there is no prescribed ordering. Note, however, that specific processing implementations may require the presence of other records in order to function, especially summary and processing parameter records.

4.3.1 GSF Record Structure

The first word of each record contains one 32-bit unsigned integer that defines the size of the data portion of the record. The second word is an identifier field consisting of a checksum flag, a reserved field and a record identification field. Figure 4-5 illustrates this structure.

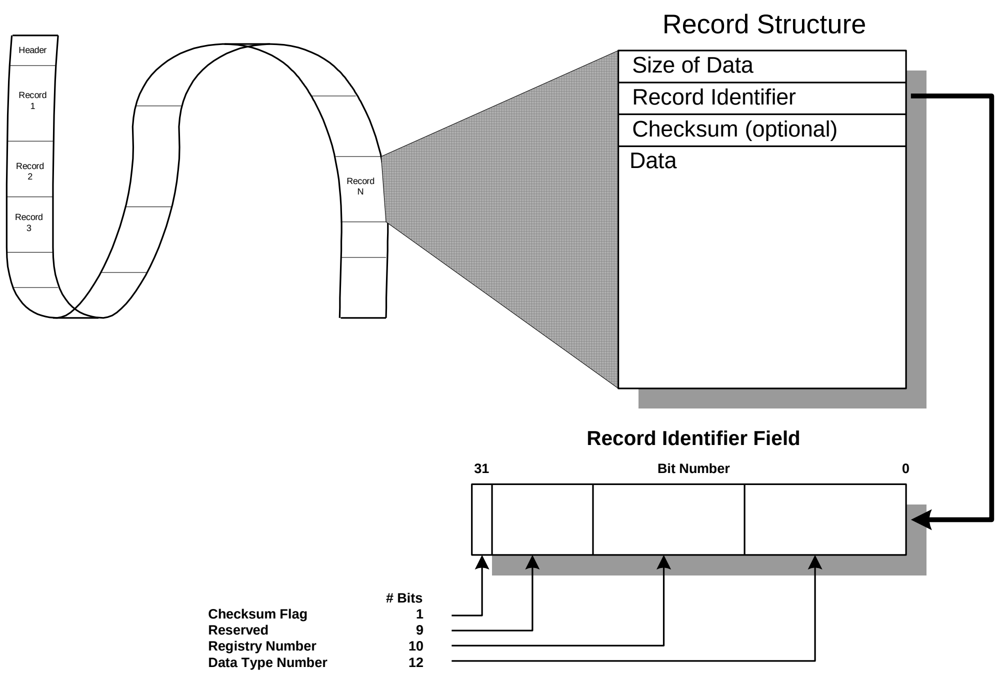

Figure 4-5 GSF Data File Structure

4.3.1.1 Checksum flag

The checksum flag is the first bit in the word; when set to one, a checksum immediately follows the record identifier.

4.3.1.2 Record identification field

The record identifier contains a number that can be related uniquely to the structure defining the data field. It is divided into registry and data type subfields to allow a distributed method of assigning these fields.

4.3.1.2.1 Registry

The registry portion of the record identifier is a ten-bit unsigned integer identifying the registrar responsible for assigning data type subfield numbers. It allows more than one group to be responsible for the assignment process by assigning registry numbers to each group. Those records, defined in Appendix A.1 of this document, have a registry number of zero. Other registry numbers are assigned to individual agencies, institutions or corporations, allowing them to define "private" data type identifiers that will not conflict with the standard ones. The group's registry number is a prefix for these private data records. Other groups need not know what types of data are contained within a private data record; they may simply ignore the record and skip to the next one. If some privately defined data types become commonly used, then reassigning them a new number with a registry number of zero and defining the data type within the standard incorporates them into the standard.

4.3.1.2.2 Data type

The data type portion of the record identifier field is a 12-bit unsigned integer that defines a specific data structure. The registrar identified in the registry portion is responsible for assigning data type numbers.

4.3.1.3 Checksum

If the checksum flag has been set, a record checksum is contained in the 32-bit word that follows the identifier field, otherwise this word is absent. If present, this word contains an integer number that is the sum of all the bytes between the checksum and the end of the record in modulo–32 form. Specifying the checksum allows GSF data to be reliably transmitted across a noisy communication path. Normally, checksums would not be used for data stored on disk.

4.3.1.4 Data record

A data structure that has been related to the data identifier by the appropriate registrar identifies the data record. The only restriction on a data record is that it must be an integral multiple of four bytes long; therefore, between zero and three empty bytes may be appended to the end of a data record.

4.3.2 GSF Record Types

As should be clear from the previous section, there are no restrictions on the type of data that can be encapsulated into Generic Sensor Format. At present, however, only bathymetry and imagery data are stored in this format. The format supports both single-beam and multibeam bathymetry data. The records currently defined include:

- a header record,
- a swath bathymetry ping record to contain multibeam bathymetry data,
- a single-beam sounding record to contain single-beam data,
- a summary record to record the temporal and spatial extremes of the data
- a sound velocity profile record,
- a navigation error record to allow the positional error estimate associated with a given data point to be described,
- an attitude record to record full time series attitude data
- a processing parameter record to define the state of the data recorded in the file,
- a sensor parameter record to record the state of the sensor when the data were produced,
- a comment record for annotating the data, and
- history records that provide an audit trail of processing that has been applied to the data.

Not all record types must be present to describe the data; for instance, a file may only consist of ping records if only those data are available or desirable. All records contain a time field consisting of precise time and will normally, but not necessarily, be in chronological order. The format of each GSF data record is defined in the following sections.

4.3.3 Header Record

The header record contains a single text field recording the version number of the GSF data file format as described in Table 4-2.

Table 4-2 Header Record Definition

Field Name	*Description*	*Field Type*	*Count*
VERSION	Version of GSF	T	12
		Header Record Size:	12

4.3.4 Swath Bathymetry Ping Record

A ping record consists of a mandatory ping header and one or more optional subrecords. Figure 4-6 shows the swath bathymetric ping record in schematic form. The normal configuration for a ping record consists of a ping header, a pair of array subrecords containing depth and acrosstrack values and other optional subrecords that may not appear in every ping. Table 4-3 defines the record's data elements including the ping header and all subrecords. Appendix A.2 defines swath bathymetric ping record identifiers.

In some cases, a subrecord may contain a set of values that applies to a series of pings. This subrecord is placed in the first record to which it applies. These values will then be considered to apply until a new instance of the subrecord appears. Subrecords which may be used in this manner include scale factor subrecords and the error array subrecords containing estimates of measurement errors, including the HORIZONTAL_ERROR_ARRAY, and VERTICAL_ERROR_ARRAY.

4.3.4.1 Ping header

A ping header consists of time, vessel's position, attitude, heading, course and speed, all of which are stored in standard form. The header also contains the number of beams in the ping's array records (defined as N for array subrecord definitions), the index, or column, number of the beam located nearest the vessel's keel, a ping flag, and both tide and depth offsets for the ping. Any tide and depth offsets present have already been added to the depth values in the ping's array records.

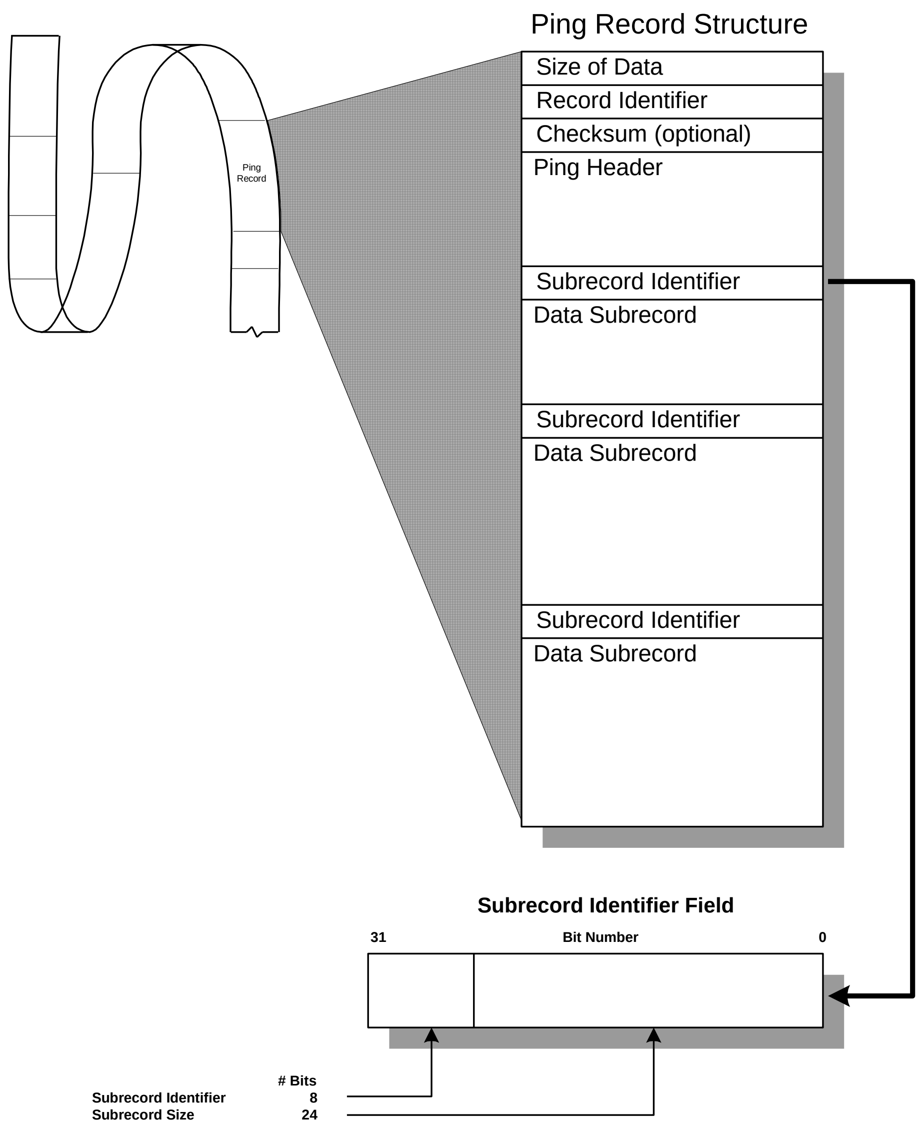

Figure 4-6 Ping record schematic

Two sets of flags are available in the ping record to provide for data to be flagged to indicate whether it is usable or not. Each ping header has a ping flag that is a 16-bit word that defines the usability of the ping's data. If the low-order bit (bit 0) of the ping flag is clear, the ping can be used for processing or display. If this bit is set, the ping data cannot be used. The remaining fifteen bits are not defined within this specification; they allow users to define implementation-specific reasons for flagging the ping. Each ping may also contain a "BEAM_FLAGS_ARRAY" that indicates whether individual beams are usable. Section 4.3.4.15 further describes beam flags.

4.3.4.2 Scale-factor subrecord

Scale factors change the range and resolution of the values in array subrecords. This allows all ocean depths to be expressed in meters with sufficient resolution, and acoustical measurements to be expressed in decibels with sufficient resolution. After applying the scale factors, all of the beam array values are encoded in external form as signed or unsigned integers. Some beam array values allow the user to define the field size to support saving the data at a fixed precision. The depth, nominal depth, along track, across track, and travel time arrays can be saved as either two-byte or four-byte integer values as specified by the user. The field size value should be specified once and then enforced for all records within a file. The beam amplitude values and beam echo width values can be saved as either one-byte or two-byte quantities. The beam array scale factor values are saved in the scale factors sub-record of the ping record. This subrecord exists for the first ping of every file, and then again whenever the scale factors change. As a disk-space saving mechanism, this subrecord is not written for every ping record.

Table 4-3 Swath Bathymetry Ping Record Definition

Field Name	***Description***	***Field Type***	***Count***
	Ping Header Subrecord		*42 in versions prior to3.01; 56 otherwise*
TIME	Time of ping transmission	I	2*4
LONGITUDE	Longitude of reference point in ten-millionths of degrees. Positive values are east longitude.	I	4
LATITUDE	Latitude of reference point in ten-millionths of degrees. Positive values are north latitude.	I	4
NUM_BEAMS	Number of beams in ping (N)	I	2
CENTER_BEAM	Location of center beam. The first beam is the outermost port beam.	I	2

Field Name	*Description*	*Field Type*	*Count*
PING_FLAGS	Flags that indicate the usability of the ping data. See section 4.3.4.1	I	2
RESERVED	Reserved for future use	I	2
TIDE_CORRECTOR	Water level correction in centimeters. This value (or the GPS tide corrector) has been added to all depth values in the ping whether they are flagged as usable or not. The ping flag field provides an indication of whether vertical control results from water level measurement or GPS heights.	I	2
DEPTH_CORRECTOR	Dynamic draft (or vessel depth for submersible vessels) in centimeters. This value has been added to all depth values in the ping.	I	4
HEADING	Ship's heading in hundredths of degrees including any offsets that have been applied to the data as documented in the processing parameter record	U	2
PITCH	Ship's pitch in hundredths of degrees including any offsets that have been applied to the data as documented in the processing parameter record	I	2
ROLL	Ship's roll in hundredths of degrees including any offsets that have been applied to the data as	I	2

Field Name	*Description*	*Field Type*	*Count*
	documented in the processing parameter record		
HEAVE	Ship's heave in centimeters	I	2
COURSE	Ship's direction of motion through water in hundredths of degrees	U	2
SPEED	Ship's speed in hundredths of knots	U	2
HEIGHT	Height of reference point above the ellipsoid (in GSF version 03.01 and higher). Positive height is above ellipsoid. Field precision is 0.001 meters. Field will be undefined following gsfRead of file created with GSF library version 1.x or 2.x.	I	4
SEPARATION	Ellipsoid to chart datum separation. (in GSF version 03.01 and higher). Positive value indicates vertical datum is above ellipsoid. Field precision is 0.001 meters. Field will be undefined following gsfRead of file created with GSF library version 1.x or 2.x.	I	4
GPS_TIDE_CORRECTOR	GPS based vertical control corrector in millimeters. (in GSF version 03.01 and higher) This value (or the tide corrector) has been added to all depth values in the ping whether they are flagged as usable or not. The ping flag field provides an indication of whether vertical control results	I	4

Field Name	***Description***	***Field Type***	***Count***
	from water level measurement or GPS heights. Field will be undefined following gsfRead of file created with GSF library version 1.x or 2.x.		
SPARE	Reserved for future use; in GSF version 03.01 and higher only.	I	2
Scale Factor Subrecord			*4+12M*
NUM_FACTORS	Number of scale factors (M)	I	4
SCALE_FACTOR_ARRAY	ID, compression flag, scale factor and offset values for each array subrecord in the ping, see section 4.3.4.2		12*M
Beam Array Subrecords. ***Some of the following arrays are used to record data from each beam.***			
DEPTH_ARRAY	Depth (z) values for each beam in meters, corrected for measured sound velocity. Scale factors applied before storage.	U	2*N, or 4*N
NOMINAL_DEPTH_ARRAY	Depth (z) values for each beam in meters, using an average sound speed of 1500 m/s. Scale factors applied before storage.	U	2*N, or 4*N
ACROSS_TRACK_ARRAY	Acrosstrack (y) values in meters. Scale factors applied before storage.	I	2*N, or 4*N

Field Name	***Description***	***Field Type***	***Count***
ALONG_TRACK_ARRAY	Alongtrack (x) values in meters. Scale factors applied before storage.	I	2*N, or 4*N
TRAVEL_TIME_ARRAY	Travel time in seconds. Scale factors applied before storage.	U	2*N, or 4*N
BEAM_ANGLE_ARRAY	Incoming beam angle at transducer face in degrees. Scale factors applied before storage.	I	2*N
MEAN_CAL_AMPLITUDE_ARRAY	Mean amplitude in decibels (referenced to 1 micropascal at 1 meter). Scale factors applied before storage.	I	1*N, or 2*N
MEAN_REL_AMPLITUDE_ARRAY	Mean amplitude in decibels relative to an arbitrary intensity. Scale factors applied before storage.	U	1*N, or 2*N
ECHO_WIDTH _ARRAY	Measured width of bottom echo in seconds. Scale factors applied before storage.	U	1*N, or 2*N
QUALITY_FACTOR_ARRAY	Measures of beam quality in arbitrary units. Meaning of each field is dependent on the sensor in use.	U	1*N

Field Name	***Description***	***Field Type***	***Count***
RECEIVE_HEAVE_ARRAY	Ship's heave at receive time in meters. Scale factors applied before storage.	I	1*N
DEPTH_ERROR_ARRAY	Estimated depth measurement error in meters. Scale factors applied before storage. ***(OBSOLETE: replaced with horizontal_error_array and vertical_error_array. New applications should use horizontal_error_array and vertical_error_array)***	U	2*N
ACROSS_TRACK_ERROR_ARRAY	Estimated across track measurement error in meters. Scale factors applied before storage. ***(OBSOLETE: replaced with horizontal_error_array and vertical_error_array. New applications should use horizontal_error_array and vertical_error_array)***	U	2*N
ALONG_TRACK_ERROR_ARRAY	Estimated along track measurement error in meters. Scale factors applied before storage. ***(OBSOLETE: replaced with horizontal_error_array and vertical_error_array. New applications should use horizontal_error_array and vertical_error_array)***	U	2*N
BEAM_FLAGS_ARRAY	Flags that indicate whether individual beam data are usable. See section 4.3.4.15	U	1*N
QUALITY_FLAGS_ARRAY	Flags provided by Reson sonar systems describing bottom detection parameters and/or	U	N/4

Field Name	*Description*	*Field Type*	*Count*
	quality. This value is packed as a two-bit quantity per beam. ***(OBSOLETE: New applications should use the quality_factor array subrecord)***		
SIGNAL_TO_NOISE_ARRAY	Signal to noise ratio of each beam.	I	1*N
BEAM_ANGLE_FORWARD_ARRAY	Beam angle in the fore-aft direction in degrees. Scale factors applied before storage.	U	2*N
VERTICAL_ERROR_ARRAY	Array of estimated vertical error (meters, at 95% confidence)	U	2*N
HORIZONTAL_ERROR_ARRAY	Array of estimated horizontal error (meters, at 95% confidence)	U	2*N
SECTOR_NUMBER_ARRAY	Array of values that specify the transit sector for this beam	U	1*N
DETECTION_INFO_ARRAY	Array of values that specify the method of bottom detection	U	1*N
INCIDENT_BEAM_ADJ_ARRAY	Array of values that specify incident beam angle adjustment from beam_angle	I	1*N
SYSTEM_CLEANING_ARRAY	Array of values that specify data cleaning information from the sensor	U	1*N
DOPPLER_CORR_ARRAY	Array of values used to correct the travel times for Doppler when transmission is FM	I	1*N
SONAR_VERTICAL_UNCERTAINTY_ARRAY	Array of values from the sonar for the component of the total vertical uncertainty (TPU) corresponding to	U	2*N

Field Name	Description	Field Type	Count
	the measurement made by the sonar.		
SONAR_HORIZONTAL_UNCERTAINTY_ARRAY	Array of values from the sonar for the component of the total horizontal uncertainty (TPU) corresponding to the measurement made by the sonar.	U	2*N
DETECTION_WINDOW_ARRAY	Array of detection window from KMALL sensors	U	2*N
MEAN_ABS_COEFF_ARRAY	Array of the mean absorbtion coefficient from KMALL Sensors	U	2*N
TVG_DB_ARRAY	TCG Decibel array used to reverse real time TVG.	I	1*N
Sensor Specific Subrecord. See Appendix B.1 for definitions.			
BRB_INTENSITY, Structure containing bathymetric receive beam time series intensities, and associated per-ping information.			
BITS_PER_SAMPLE	Number of bits per intensity sample.	I	1
APPLIED_CORRECTIONS	Flags to describe corrections applied to intensity values.	I	4
SPARE	Reserved for future use.	I	16
SENSOR_IMAGERY	*Sensor specific imagery information. See Appendix B.3 for definitions.*		
TIME_SERIES_INTENSITY, Array of structures containing the per-beam time series intensity information.			***Size*N***
SAMPLE_COUNT	Number (Ns) of intensity samples for this beam.	I	2

Field Name	***Description***	***Field Type***	***Count***
DETECT_SAMPLE	0-Based index of bottom detection sample for this beam.	I	2
START_RANGE_SAMPLES	KMALL Start of sample Index	I	2
SPARE	Reserved for future use.	I	6
SAMPLES_ARRAY	Array of Ns intensity samples, in dB.	I	4*Ns
		Swath Bathymetry Ping Record Size:	variable

Figure 4-7 describes scale factor subrecords schematically. After the subrecord identifier is a count that defines the number of scale factors listed within the subrecord. Following the count are arrays of scale factors, one for each array subrecord used within the GSF data file. Each scale factor array element consists of the subrecord ID of the array subrecord being scaled, a compression flag describing the type of compression applied to the array subrecord and two scale factors, a multiplier and an offset. The one-byte compression flag is split into two sections. The high order four bits are used to control the field size for those array values that support more than one field size. The low order four bits are reserved for future use to specify an optional compression algorithm. In order to transform the values in the array subrecord into the engineering units defined Table 4-3, each element in the array must be divided by the multiplier and the offset subtracted from the result.

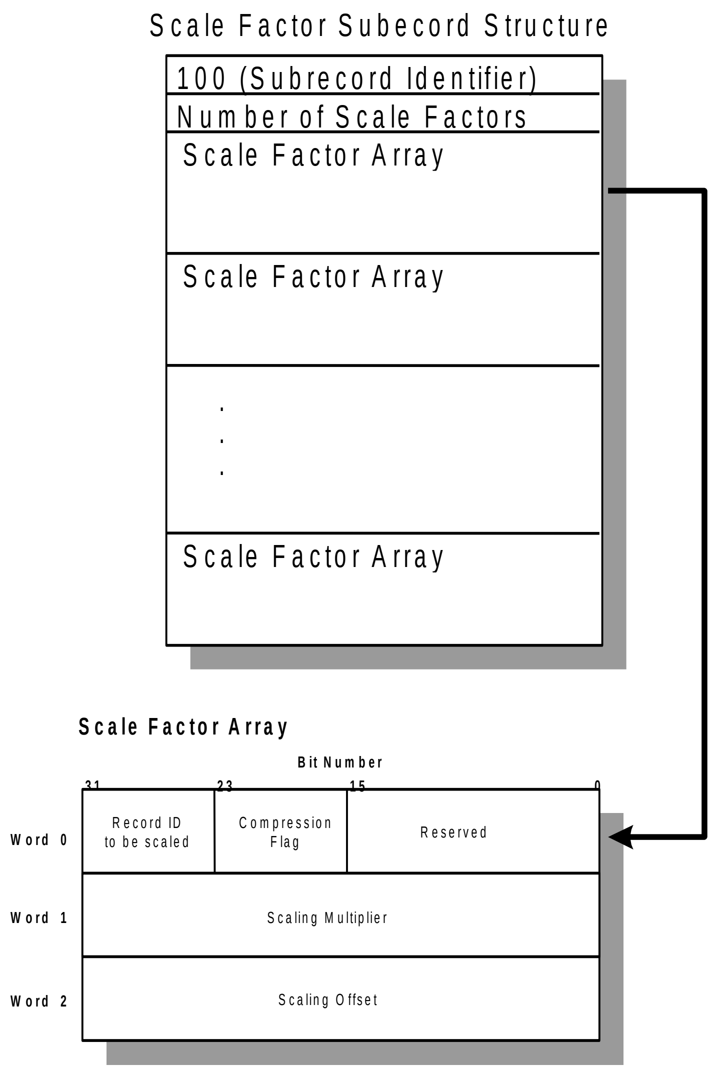

Figure 4-7 Ping Scale Factor Subrecord Schematic

4.3.4.3 Array subrecords

The major portion of a ping record consists of several array subrecords, each containing one kind of measurement derived for each beam. These arrays contain the data that are associated with each beam of the ping being described; examples of these data include the geometric location of the bathymetric point, parameters that describe the acoustic nature of the return or parameters that describe the statistical nature of the depth measurement. Table 4-3 defines valid array subrecords; subsequent sections describe these array subrecords in more detail. Some array subrecords are composed of either 8-bit or 16-bit integers that may represent either signed or unsigned quantities depending upon the kind of data they contain. For each array subrecord, the first beam is the outermost port beam.

4.3.4.4 Depth Array Subrecord

This field contains an array of depth values, one for each beam in the ping. Each depth value is encoded either as a 2-byte integer or as a 4-byte integer as specified by the field size component of the compression flag. The processing parameter record describes the calculation of the depths in the depth array. The units are meters before being scaled as defined in the scaling factor subrecord.

4.3.4.5 Nominal Depth Array Subrecord

This field contains an array of nominal depth values, one for each beam in the ping. The nominal depth values are relative to a fixed 1500 m/s sound speed profile. The corresponding across-track and along-track arrays are populated to properly locate the sounding point on the seafloor which requires ray tracing through the sound speed profile. For the case of a modern multibeam sonar, the nominal depth values are computed using the sonar's reported travel time array, the sonar's reported true depth array, and the sound speed profile. The nominal depth field is provided for sonar systems that are capable of producing two depth values, one (true depth) calculated using a measured sound velocity profile and another (nominal depth) calculated using a fixed sound speed of 1500 m/s. Note that if only one depth value is available it is written into the depth array no matter how the depths have been calculated. Each nominal depth value is encoded as a 2-byte integer, or as a 4-byte integer as specified by the field size component of the compression flag. The units are meters before being scaled as defined in the scaling factor subrecord.

4.3.4.6 Acrosstrack Array Subrecord

This field contains an array of acrosstrack distances, one for each beam in the ping. Each distance value is encoded as a 2-byte integer or as a 4-byte integer as specified by the field size component of the compression flag. The units are meters before being scaled as defined in the scaling factor subrecord.

4.3.4.7 Alongtrack Array Subrecord

This field contains an array of alongtrack distances for each beam in the ping. Each distance is encoded as a 2-byte integer or as a 4-byte integer as specified by the field size component of the compression flag. The units are meters before being scaled as defined in the scaling factor subrecord.

4.3.4.8 Travel-time Array Subrecord

This field contains an array of travel times for each beam in the ping. Each time is encoded as a 2-byte integer or as a 4-byte integer as specified by the field size component of the compression flag. The units are seconds before being scaled as defined in the scaling factor subrecord.

4.3.4.9 Beam-angle Array Subrecord

This field contains an array of beam angles for each beam in the ping. Each angle is encoded as a 2-byte integer. The units are degrees before being scaled as defined in the scaling factor subrecord. Each beam angle represents the rotation from vertical of the beam, so that beams pointed straight down have a “vertical” angle of zero. The range of vertical angle values is 0-180 degrees (downward looking sonars have a practical range of 0-90 degrees, with 90 degrees being horizontal).

4.3.4.10 Mean Calibrated Amplitude Array Subrecord

This field contains an array of average calibrated amplitude values for each beam. Each amplitude value is encoded as a 1-byte integer or as a 2-byte integer as specified by the field size component of the compression flag. The units are in decibels (re 1 micropascal at 1 meter) before being scaled as defined in the scaling factor subrecord.

4.3.4.11 Mean Relative Amplitude Array Subrecord

This field contains an array of average relative (uncalibrated) amplitude values for each beam in the ping. Each amplitude value is encoded as a 1-byte integer or as a 2-byte integer as specified by the field size component of the compression flag. The units are in decibels (re 1 micropascal at 1 meter) before being scaled as defined in the scaling factor subrecord.

4.3.4.12 Echo Width Array Subrecord

This field contains an array of width of the bottom echoes for each beam. Each time is encoded as a 1-byte integer or as a 2-byte integer as specified by the field size component of the compression flag. The units are seconds before being scaled as defined in the scaling factor subrecord.

4.3.4.13 Quality factor Array Subrecord

This field contains measures of beam quality in arbitrary sensor-dependent units, one for each beam in the ping.

In the case of Reson sonars, the quality factor for each beam will be a value from 0 to 15, which represents the 4-bit quality value from the Reson R-Theta message (8100 series) or the 7006 datagram (7100 series). (Note: Some implementations of GSF include Reson brightness and co-linearity flags in the packed 2-bit array subrecord referenced below. That subrecord should no longer be used, and this quality factor array should be used in its place.)

For Kongsberg EM series sonars, the quality factor for each beam will be a value from 0 to 254, which represents the 8-bit quality factor contained in the Kongsberg Depth datagram.

For the ELAC 1180 MKII, the quality factor will be a value from 1 to 8, where 1 is best quality and 8 is worst quality.

The quality factor for Seabeam 2112 sonars is will be a value from 0 to 3, where the lowest order bit will be set if the beam was flagged by the sonar as poor quality. The second lowest order bit is set if the data source is *Weighted Mean Time* (WMT). The data source is *Bearing Direction Indicator* (BDI) if the second bit is not set.

4.3.4.14 Receive Heave Array Subrecord

This field contains the platform's heave at receive time for each beam. Each heave is encoded as a 1-byte integer. The units are meters before being scaled as defined in the scaling factor subrecord.

4.3.4.15 Beam Flags Array Subrecord

This field contains flags that indicate the usability of the data in each beam in the ping. Each beam is represented by a 1-byte (8-bit) set of flags that indicate whether individual beams within a ping are usable or not. If the low-order bit (bit 0) of a given beam flag is clear the corresponding beam data are usable; if the bit is set that beam's data are not to be used for processing or display. The meaning of the remaining seven bits are not defined within this specification.

4.3.4.16 Quality Flags Array Subrecord

This field contains integers that consist of four 2-bit arrays. Each 2-bit array indicates information about the data in each beam in the ping. The meaning of the bit flags is dependent on the sensor in use. This beam array subrecord is considered obsolete, but is left in place for backwards compatibility. Future use of this type of information should make use of the Quality Factor array Subrecord.

4.3.4.17 Signal to Noise Array Subrecord

This field contains the signal to noise ratio (SNR) for each beam. SNR is encoded as a 1-byte integer. The values have no units and are scaled as defined in the scaling factor subrecord.

4.3.4.18 Beam Angle Forward Array Subrecord

This field contains an array of beam angles for each beam in the ping. Each angle is encoded as a 2-byte integer. The units are degrees before being scaled as defined in the scaling factor subrecord. The beam angle forward is the azimuth of the beam measured counterclockwise from directly to starboard. The range of the azimuthal angle is 0 - 360 degrees.

4.3.4.19 Vertical Error Array Subrecord

This field contains an array of vertical distances for each beam in a ping. Each distance is encoded as a 2-byte integer. The units are meters before being scaled as defined in the scaling factor subrecord. This subrecord is provided with the intent that when used in conjunction with the Horizontal Error Subrecord will functionally replace the currently defined error subrecords (DEPTH_ERROR_ARRAY, ACROSS_TRACK_ERROR_ARRAY, ALONG_TRACK_ERROR_ARRAY).

4.3.4.20 Horizontal Error Array Subrecord

This field contains an array of horizontal distances for each beam in a ping. Each distance is encoded as a 2-byte integer. The units are meters before being scaled as defined in the scaling factor subrecord. This subrecord is provided with the intent that when used in conjunction with the Vertical Error Subrecord will functionally replace the currently defined error subrecords (DEPTH_ERROR_ARRAY, ACROSS_TRACK_ERROR_ARRAY, ALONG_TRACK_ERROR_ARRAY).

4.3.4.21 Sector Number Array Subrecord

This field contains an array of transmit sector numbers for each beam in a ping. Each value is encoded as a 1-byte integer. The field value is dimensionless before being scaled as defined in the scaling factor subrecord. This value is used to record which transmit sector was used for each depth measurement in the ping.

4.3.4.22 Detection Info Array Subrecord

This field contains an array of bottom detection parameters for each beam in a ping. Each field is encoded as a 1-byte integer. The units are dimensionless before being scaled as defined in the scaling factor subrecord.

4.3.4.23 Incident Beam Adjustment Array Subrecord

This field contains an array of incident beam adjustment angles for each beam in a ping. This field contains the beam angle correction for ray-bending that is required to calculate the beam's true incidence angle on the seafloor. Each field is encoded as a 1-byte integer. The units are expressed in degrees before being scaled as defined in the scaling factor subrecord.

4.3.4.24 System Cleaning Array Subrecord

This field contains an array of sonar system data cleaning/filtering parameters for each beam in a ping. As of the GSFv2.07 release, this field is reserved for future use. Each field is encoded as a 1-byte integer. The units are dimensionless before being scaled as defined in the scaling factor subrecord.

4.3.4.25 Doppler Correction Array Subrecord

This field contains an array of Doppler correction values for each beam in a ping. The value in this field has already been applied to the reported travel time array values in order to compensate for Doppler correction. This field is only populated for sonar systems that employ transmit frequency modulation (FM). Each field is encoded as a 1-byte integer. The units are expressed in seconds before being scaled as defined in the scaling factor subrecord.

4.3.4.26 Sonar Vertical Uncertainty Array Subrecord

This field contains an array of vertical uncertainty values supplied by the sonar for each beam in a ping. These values represent the vertical uncertainty in the sonar's measurements. This field is only populated for sonar systems that provide this type of value. The units are expressed as meters before being scaled as defined in the scaling factor subrecord.

4.3.4.27 Sensor-specific Subrecords

These subrecords are designed to contain data that are not beam-oriented and that vary from ping to ping, but do not fit into the ping header. An example of this type of data might be the power amplifier gain settings for a particular ping. These data are, by nature, specific to a particular sonar system or manufacturer and are defined to ensure that all the data available in a particular ping record can be recorded. Because of the specificity of these data, these subrecords are usually located at the end of the ping record and may be ignored by the majority of processing and display software. Appendix B.1 defines the sensor-specific subrecords. It is important to note the presence of the sensor specific subrecord may identify the sensor that produced the data. Therefore, it may be desirable to define two different subrecords with identical data elements because the different sensor-specific subrecord identifiers identify the sensor.

4.3.4.28 Bathymetric Receive Beam Time Series Intensity Subrecord

This subrecord is designed to contain imagery data for each of the bathymetric receive beams. This record contains the number of bits per sample encoded as a 1-byte integer and a bitmasked set of flags describing the corrections that have been applied to the intensity values, encoded as a 4-byte integer. This record also contains 16 spare header bytes per ping and sensor specific data that is per-ping and relative to imagery. This record also contains an array of Intensity Time Series structures containing information for each beam in a ping. Each element in this array is a set of values that define the per-beam time series intensity information. These values are: the number of samples for the beam encoded as a 2-byte integer, the index of the sample that represents the bottom detection point for the beam encoded as a 2-byte integer, 8 spare bytes, and an array of samples for the beam encoded as a 1-byte integer. The samples in the array represent logarithmic intensity referenced to unity, in half dB steps, and are ordered increasing in range.

4.3.4.29 TVG Decibel Array Subrecord

This subrecord contains an array of real time TVG decibel values supplied by the sonar for each beam in a ping. is encoded as a 1-byte integer. The values have no units and are scaled as defined in the scaling factor subrecord.

This is used to reverse real time TVG.

4.3.5 Single-beam Sounding Record

(*This record should no longer be used, as of GSF v2.03. While this record is still supported, single-beam data should now be stored in the Swath Bathymetry Ping Record, with number of beams set to one.)*

Table 4-4 defines the single beam sounding record. The basis for the single beam sounding record is the swath bathymetry ping record, but the single beam sounding record is much simpler.

Table 4-4 Single-beam Sounding Record Definition

Field Name	***Description***	***Field Type***	***Count***
TIME	Time of sounding	I	2*4
LONGITUDE	Longitude of ship in ten-millionths of degrees	I	4
LATITUDE	Latitude of ship in ten-millionths of degrees	I	4
TIDE_CORRECTOR	Tidal offset in centimeters.	I	2

Field Name	***Description***	***Field Type***	***Count***
DEPTH_CORRECTOR	Dynamic draft (or vessel depth for submersible vessels) in centimeters.	I	4
HEADING	Ship's heading in .01 degrees including any offsets that have been applied to the data as documented in the processing parameter record	U	2
PITCH	Ship's pitch in .01 degrees including any offsets that have been applied to the data as documented in the processing parameter record	I	2
ROLL	Ship's roll in .01 degrees including any offsets that have been applied to the data as documented in the processing parameter record	I	2
HEAVE	Ship's heave in centimeters	I	2
DEPTH	Sounding depth in centimeters	I	4
SOUND_SPEED_ CORRECTION	Sound speed correction in meters	I	2
POSITIONING_ SYSTEM_TYPE	ID for type of positioning system.	U	2
Sensor Specific Subrecord. See Appendix B.2 for definitions			
		Single-beam Sounding Record Size	38 + sensor specific

4.3.6 Summary Record

The summary record contains a temporal and spatial synopsis of the data stored in the file. These records allow application programs to rapidly determine whether the data in the file are of interest. Table 4-5 defines the format of a summary record.

Table 4-5 Summary Record Definition

Field Name	***Description***	***Field Type***	***Count***
BEGIN_TIME	Time of earliest record in file	I	2*4
END_TIME	Time of latest record in file	I	2*4
MIN_LATITUDE	Southernmost extent of data records	I	4
MIN_LONGITUDE	Westernmost extent of data records	I	4
MAX_LATITUDE	Northernmost extent of data records	I	4
MAX_LONGITUDE	Easternmost extent of data records	I	4
MIN_DEPTH	Least depth in data records	I	4
MAX_DEPTH	Greatest depth in data records	I	4
		Summary Record Size	***40***

4.3.7 Sound Velocity Profile Record

The sound velocity profile record contains values of sound velocity used in estimating individual sounding locations. It consists of; the time the profile was observed, the time it was introduced into the sounding location procedure, the position of the observation, the number of points in the profile, and the individual points, expressed as depth and sound velocity pairs. Table 4-6 defines the format of a sound velocity profile record.

Table 4-6 Sound Velocity Profile Record Definition

Field Name	*Description*	*Field Type*	*Count*
OBS_TIME	Time SVP was observed.	I	2*4
APP_TIME	Time SVP was applied to sonar data.	I	2*4
LONGITUDE	Longitude of SVP observation in ten-millionths of degrees.	I	4
LATITUDE	Latitude of SVP observation in ten-millionths of degrees.	I	4
NUM_POINTS	Number of points in SVP observation (S).	I	4
SVP_ARRAY	Depth and sound velocity pair for each observation point, in centimeters and hundredths of meters/second, respectively.	I	4*2*S
		SVP Record Size	***28+8*S***

4.3.8 Processing Parameter record

Processing parameter records contain important scalar or vector values that describe overall survey conditions or operational values. Typical parameters include items such as the navigation sensor's antenna location or the reference ellipsoid for the geographic position. Table 4-7 defines the format of a processing parameter record. Each processing parameter record contains a time, a count of the parameters defined within the record, and a text string for each parameter definition. The string's length begins each parameter text string.

Table 4-7 Processing Parameter Record Definition

Field Name	*Description*	*Field Type*	*Count*
TIME	Time of processing parameter validity.	I	2*4
NUM_PARAMS	Number of processing parameters in record (P).	I	2
PARAM_SIZE(1)	Size of first processing parameter (P1).	I	2

Field Name	***Description***	***Field Type***	***Count***
PARAM_TEXT(1)	Text containing first processing parameter, see section 4.3.8.	T	P1
. . .	. . .		
. . .	. . .		
PARAM_SIZE(P)	Size of first processing parameter (PN).	I	2
PARAM_TEXT(P)	Text containing Pth processing parameter, see section 4.3.8.	T	PN
		Processing Parameter Record Size:	***Variable***

The parameter text string consists of a parameter keyword followed by an equals sign ("=") and then the value of the parameter, e.g., "KEYWORD=VALUE". Corrections or offsets that refer to the ship are in absolute ship-based coordinates as defined in section 3.4. These values are in meters relative to the origin of the coordinate system. Each such correction has both "APPLIED" and "TO_APPLY" values. This allows for the storage of corrections that are known when the data are recorded but have not been applied to the data. Table 4-8 defines the necessary processing parameter records. The first column defines acceptable keywords, the second defines a description of the values.

Table 4-8 Defined Processing Parameter Text Strings

Keyword	***Description***
"REFERENCE TIME"	String description of the beginning of the time epoch. Two choices for the beginning time are allowed. For recently collected data, the beginning of the epoch is often defined to be 1 January 1970 because many computers use this convention. An alternative beginning, especially for data

Keyword	*Description*
	collected prior to this date, is midnight of the beginning date of the survey. In any case, the format for the reference time consists of the full four-digit year, the ordinal day of year and the time expressed as hour, minute and second. Format: CCYY/DDD HH:MM:SS Example: "1970/001 00:00:00"
"ROLL_COMPENSATED"	Indicates whether the sounding data have been roll compensated. Format: "YES" or "NO"
"PITCH_COMPENSATED"	Indicates whether the sounding data have been pitch compensated. Format: "YES" or "NO"
"HEAVE_COMPENSATED"	Indicates whether the sounding data have been heave compensated. Format: "YES" or "NO"
"TIDE_COMPENSATED"	Indicates whether the sounding data have been tide compensated. Format: "YES" or "NO"
"DEPTH_CALCULATION"	Indicates whether the sounding data have been computed by integrating travel time through the water column; this is a "corrected" computation of depth. An alternative method for computing depth is to assume a constant sound speed, usually of 1500 meters/second. Note that this does not

Keyword	***Description***
	refer to the data contained in the NOMINAL_DEPTH_ARRAY subrecord of the ping record. Format: "CORRECTED” or "RELATIVE_TO_1500_MS”
"RAY_TRACING"	Indicates whether the angle/travel-time pairs have been corrected for ray tracing. Format: "YES” or "NO”
“PLATFORM_TYPE”	Specifies the platform used to collect the data. Format: “AUV” or “SURFACE_SHIP”
“FULL_RAW_DATA”	Format: “TRUE” or “FALSE” This parameter is used to indicate whether there is sufficient information in the data file to support a full recalculation of the depth, across-track and along-track values from the raw measurements.
“MSB_APPLIED_TO_ATTITUDE”	Used to indicate whether the motion sensor bias values - determined from the patch test – have been added to the roll, pitch, and heading values in the attitude records and in the ping record. Format: “YES” or “NO”
“HEAVE_REMOVED_FROM_GPS_TC”	Used to indicate whether the heave value has been removed from the

Keyword	*Description*
	GPS tide corrector value saved in the ping record. Format: “YES” or “NO”
"DRAFT_TO_APPLY"	Value of a draft offset that is known, but has not yet been applied. More than one offset may be described to allow for sensors with more than one transducer. If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "+02.84,+02.73”" " This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“PITCH_TO_APPLY”	Value of a pitch offset that is known, but has not yet been applied. More than one offset may be described to allow for sensors with more than one transducer. If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "+00.68,-01.03” This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not

Keyword	*Description*
	recommended. This parameter may be deprecated in a future version.
"ROLL_TO_APPLY"	Value of a roll offset that is known, but has not yet been applied. More than one offset may be described to allow for sensors with more than one transducer. If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "-00.13" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"GYRO_TO_APPLY"	Value of a heading offset that is known, but has not yet been applied. More than one offset may be described to allow for sensors with more than one transducer. If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "-00.50" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.

Keyword	***Description***
"POSITION_OFFSET_TO_APPLY"	Location of the ship's position reference (e.g., the IMU, or the navigation antenna) that is known but has not yet been applied. Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: "+05.30,-01.20,+03.62" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"ANTENNA_OFFSET_TO_APPLY"	Location of the ship's navigation antenna that is known but has not yet been applied. Format: +XX.XX,+YY.YY,+ZZ.ZZ This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version. Example: "+05.30,-01.20,+03.62"
"TRANSDUCER_OFFSET_TO_APPLY"	Location of the ship's sensor transducer that is known but has not yet been applied. More than one location may be described to allow for sensors with more than one transducer. If six values are provided, the first three apply to the port transducer and the last three apply to the starboard transducer. Format: +XX.XX,+YY.YY,+ZZ.ZZ or +XX.XX,+YY.YY,+ZZ.ZZ,+XX.XX,+YY.YY,+ZZ.ZZ

Keyword	*Description*
	Example: "+05.30,-01.20,+03.62,+05.28,+01.76,+03.68" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"TRANSDUCER_PITCH_OFFSET_TO_APPLY"	Installation misalignment of the transducer with respect to the platform in the pitch axis. Format: +DD.DD or +DD.DD, +DD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"TRANSDUCER_ROLL_OFFSET_TO_APPLY"	Installation misalignment of the transducer with respect to the platform in the roll axis. Format: +DD.DD or +DD.DD, +DD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"TRANSDUCER_HEADING_OFFSET_TO_APPLY"	Installation misalignment of the transducer with respect to the platform in the heading axis.

Keyword	Description
	Format: +DDD.DD or +DDD.DD, +DDD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"MRU_PITCH_TO_APPLY"	Value of a pitch offset for the motion sensor that is known, but has not yet been applied. Format: +DD.DD Example: "+00.13" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"MRU_ROLL_TO_APPLY"	Value of a roll offset for the motion sensor that is known, but has not yet been applied. Format: +DD.DD Example: "+00.13" This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"MRU_HEADING_TO_APPLY"	Value of a heading offset for the motion sensor that is known, but has not yet been applied.

Keyword	*Description*
	Format: +DDD.DD Example: “-01.48” This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“MRU_OFFSET_TO_APPLY”	Location of the ship’s motion sensor that is known but has not yet been applied. Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: “+02.15,-01.88,+02.91” This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“CENTER_OF_ROTATION_OFFSET_TO_APPLY”	Location of the ship’s center of rotation that is known but has not yet been applied. Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: “+02.15,-01.88,+02.91” This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“POSITION_LATENCY_TO_APPLY“	Known latency of position data that has not yet been applied. Format: +X.XXX

Keyword	*Description*
	This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“ATTITUDE_LATENCY_TO_APPLY“	Known latency of attitude data that has not yet been applied. Format: +X.XXX This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“DEPTH_SENSOR_LATENCY_TO_APPLY“	Known latency of depth sensor data that has not yet been applied. Format: +X.XXX This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“DEPTH_SENSOR_OFFSET_TO_APPLY”	Known position offset of the depth sensor data that has not yet been applied. Format: +XX.XX, +YY.YY, +ZZ.ZZ This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.

Keyword	***Description***
“RX_TRANSDUCER_OFFSET_TO_APPLY”	Known position offset of the receiver transducer that has not yet been applied. More than one offset may be described to allow for systems with more than one transducer. Format: +XX.XX, +YY.YY, +ZZ.ZZ or +XX.XX, +YY.YY, +ZZ.ZZ, +XX.XX, +YY.YY, +ZZ.ZZ This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“RX_TRANSDUCER_PITCH_OFFSET_TO_APPLY”	Known pitch offset of the receiver transducer that has not yet been applied. More than one offset may be described to allow for systems with more than one transducer. Format: +DD.DD or +DD.DD, +DD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
“RX_TRANSDUCER_ROLL_OFFSET_TO_APPLY”	Known roll offset of the receiver transducer that has not yet been applied. More than one offset may be described to allow for systems with more than one transducer. Format: +DD.DD or

Keyword	***Description***
	+DD.DD, +DD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"RX_TRANSDUCER_HEADING_OFFSET_TO_APPLY"	Known heading offset of the receiver transducer that has not yet been applied. More than one offset may be described to allow for systems with more than one transducer. Format: +DDD.DD or +DDD.DD, +DDD.DD This parameter is provided for historical purposes. Use of this value to record non-zero offsets not yet applied is not recommended. This parameter may be deprecated in a future version.
"APPLIED_DRAFT"	Value of the draft offset that has been applied to the sounding data. More than one offset may be described to allow for sensors with more than one transducer. If the correction is not known, then the applied draft correction is identified as "UNKNWN". If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD

Keyword	*Description*
	Example: "+02.84,+02.73" or "UNKNWN,UNKNWN"
"APPLIED_PITCH_BIAS"	Value of the pitch offset that has been applied to the sounding data. More than one offset may be described to allow for sensors with more than one transducer. If the correction is not known, then the applied pitch correction is identified as "UNKNWN". If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "-01.34,+00.31" or "UNKNWN"
"APPLIED_ROLL_BIAS"	Value of the roll offset that has been applied to the sounding data. More than one offset may be described to allow for sensors with more than one transducer. If the correction is not known, then the applied roll correction is identified as "UNKNWN". If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "-01.06," or "UNKNWN,UNKNWN"
"APPLIED_GYRO_BIAS"	Value of the heading offset that has been applied to the sounding data. More than one offset may be described

Keyword	*Description*
	to allow for sensors with more than one transducer. If the correction is not known, then the applied heading correction is identified as "UNKNWN". If more than one value is provided, the first value applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD,+DD.DD Example: "+01.30,+01.00" or "UNKNWN,UNKNWN"
"APPLIED_POSITION_OFFSET"	Location of the ship's position reference (e.g., the navigation antenna) that has been applied to the sounding data. If the position offset is not known, then the applied offset is identified as "UNKNWN". Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: "+05.30,-01.20,+03.62" or "UNKNWN,UNKNWN,UNKNWN"
"APPLIED_ANTENNA_OFFSET"	Location of the ship's antenna reference (e.g., the selected navigation system antenna) that has been applied to the sounding data. If the position offset is not known, then the applied offset is identified as "UNKNWN". Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: "+05.30,-01.20,+03.62" or "UNKNWN,UNKNWN,UNKNWN"
"APPLIED_TRANSDUCER_OFFSET"	Location of the ship's sensor transducer that has been applied to the data.

Keyword	*Description*
	More than one location may be described to allow for sensors with more than one transducer. If the transducer offset is not known, then the applied offset is identified as "UNKNWN". If six values are provided, the first three apply to the port transducer and the last three apply to the starboard transducer. Format: +XX.XX,+YY.YY,+ZZ.ZZ or +XX.XX,+YY.YY,+ZZ.ZZ,+XX.XX,+YY.YY,+ZZ.ZZ Example: "+05.30,-01.20,+03.62,+05.28,+01.76,+03.68" or "UNKNWN,UNKNWN,UNKNWN,UNKNWN,UNKNWN,UNKNWN"
"APPLIED_TRANSDUCER_PITCH_OFFSET"	Installation misalignment of the transducer with respect to the platform in the pitch axis. More than one offsets may be described to allow for sensors with more than one transducer. If two values are provided, the first applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD, +DD.DD Example: "+00.13"
"APPLIED_TRANSDUCER_ROLL_OFFSET"	Installation misalignment of the transducer with respect to the platform in the roll axis. More than one offsets may be described to allow for sensors with more than one transducer. If two values are provided, the first applies to

Keyword	Description
	the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD, +DD.DD Example: “+00.13”
“APPLIED_TRANSDUCER_HEADING_OFFSET”	Installation misalignment of the transducer with respect to the platform in the heading axis. More than one offsets may be described to allow for sensors with more than one transducer. If two values are provided, the first applies to the port transducer and the second applies to the starboard transducer. Format: +DDD.DD or +DDD.DD, +DDD.DD Example: “+00.13”
“APPLIED_MRU_PITCH”	Value of a pitch offset for the motion sensor that has been applied to the data. Format: +DD.DD Example: “+00.13”
“APPLIED_MRU_ROLL”	Value of a roll offset for the motion sensor that has been applied to the data. Format: +DD.DD Example: “+00.13”
“APPLIED_MRU_HEADING”	Value of a heading offset for the motion sensor that has been applied to the data.

Keyword	*Description*
	Format: +DDD.DD Example: “-01.48”
“APPLIED_MRU_OFFSET”	Location of the ship's motion sensor that has been applied to the data. Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: "+02.15,-01.88,+02.91”
“APPLIED_CENTER_OF_ROTATION_OFFSET”	Location of the ship's center of rotation that has been applied to the data. Format: +XX.XX,+YY.YY,+ZZ.ZZ Example: "+02.15,-01.88,+02.91”
“APPLIED_POSITION_LATENCY “	Latency in seconds of position data that has already been applied. Format: X.XXX. Example: “0.050”
“APPLIED_ATTITUDE_LATENCY “	Latency in seconds of attitude data that has already been applied. Format: X.XXX. Example: “0.030”
“APPLIED_DEPTH_SENSOR_LATENCY “	Latency in seconds of depth sensor data that has already been applied. Format: X.XXX. Example: “0.100”
“APPLIED_DEPTH_SENSOR_OFFSET”	Position offsets of the location of the depth sensor. Format: +XX.XX, +YY.YY, +ZZ.ZZ
“APPLIED_RX_TRANSDUCER_OFFSET”	Location of the ship’s receiver transducer that has been applied to the data. More than one location may be described to allow for systems with more than one transducer. If the transducer offset is not known, then the

Keyword	Description
	applied offset is identified as "UNKNWN". If six values are provided, the first three apply to the port transducer and the last three apply to the starboard transducer. Format: +XX.XX,+YY.YY,+ZZ.ZZ or +XX.XX,+YY.YY,+ZZ.ZZ,+XX.XX,+YY.YY,+ZZ.ZZ Example: "+05.30,-01.20,+03.62,+05.28,+01.76,+03.68" or "UNKNWN,UNKNWN,UNKNWN,UNKNWN,UNKNWN,UNKNWN"
"APPLIED_RX_TRANSDUCER_PITCH_OFFSET"	Offset on the pitch axis that has been applied to the receiver transducer. More than one offset may be described to allow for systems with more than one transducer. If the transducer offset is not known, then the applied offset is identified as "UNKNWN". If two values are provided, the first applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD, +DD.DD Example: "+01.30" "UNKNWN,UNKNWN"
"APPLIED_RX_TRANSDUCER_ROLL_OFFSET"	Offset on the roll axis that has been applied to the receiver transducer. More than one offset may be described to allow for systems with more than one transducer. If the transducer offset is not known, then the applied offset is

Keyword	*Description*
	identified as “UNKNWN”. If two values are provided, the first applies to the port transducer and the second applies to the starboard transducer. Format: +DD.DD or +DD.DD, +DD.DD Example: “+24.38, -31.15” “UNKNWN,UNKNWN”
“APPLIED_RX_TRANSDUCER_HEADING_OFFSET”	Offset on the rheadin axis that has been applied to the receiver transducer. More than one offset may be described to allow for systems with more than one transducer. If the transducer offset is not known, then the applied offset is identified as “UNKNWN”. If two values are provided, the first applies to the port transducer and the second applies to the starboard transducer. Format: +DDD.DD or +DDD.DD, +DDD.DD Example: “+359.84, +358.15” “UNKNWN,UNKNWN”
"GEOID"	Definition of the horizontal datum in text form. Text is for informational purposes only, but should be descriptive enough to uniquely identify the datum. If the horizontal datum is not known, the value is identified as "UNKNOWN”. For example, "WGS-84”.

Keyword	*Description*
"TIDAL_DATUM"	Definition of the reference vertical datum in text form. If the tidal datum is not known, the value is identified as "UNKNOWN”. For example, "MLW” or "ALAT”.
"UTC_OFFSET"	All times in GSF are relative to UTC. This parameter provides a mechanism to record the time zone offset that was applied to convert the times to UTC.
"NUMBER_OF_TRANSMITTERS"	This is the number of transmitter modules installed for the sonar.
"NUMBER_OF_RECEIVERS"	This is the number of receiver modules installed for the sonar.
"ROLL_REFERENCE"	This flag indicates whether roll is referenced to the horizontal (HORIZONTAL_PITCH_AXIS), or the rotated pitch axis (ROTATED_PITCH_AXIS).

4.3.9 Sensor Parameter record

Sensor parameter records contain parameters that are transmitted by the sonar at times such as startup, shutdown or when the sensor's mode of operation changes. Typical parameters include the sensor's mode, sensor offset locations, and draft compensation values. Table 4-9 defines the format of a sensor parameter record. Each sensor parameter record contains a time, a count of the parameters defined within the record, and a text string for each parameter definition. Each text string is prefixed by string length. The text string consists of a parameter keyword followed by an equals sign (“=”) and then the value of the parameter. Sensor parameter records are by nature sensor-specific, therefore there are no standard keywords defined for these parameters. Important values such as draft correctors or sensor locations are reproduced in the processing parameter record.

Table 4-9 Sensor Parameter Record Definition

Field Name	***Description***	***Field Type***	***Count***
TIME	Time of sensor parameter validity.	I	2*4
NUM_PARAMS	Number of sensor parameters in record (Q).	I	2
PARAM_SIZE(1)	Size of first sensor parameter (Q1).	I	2
PARAM_TEXT(1)	Text containing first sensor parameter, see section 4.3.9.	T	Q1
. . .	. . .		
. . .	. . .		
PARAM_SIZE(Q)	Size of first sensor parameter (QN).	I	2
PARAM_TEXT(Q)	Text containing Qth sensor parameter, see section 4.3.9.	T	QN
		Sensor Parameter Record Size:	***Variable***

4.3.10 Comment record

The comment record maintains information that is not otherwise accommodated by the other records. It consists of a time, a text string and the length of the string. One use might be to include entry of watch personnel comments during a survey. Table 4-10 defines the format of a comment record.

Table 4-10 Comment Record Definition

Field Name	***Description***	***Field Type***	***Count***
TIME	Time of comment.	I	2*4
TEXT_LENGTH	Number of characters in text (R).	I	4
COMMENT_TEXT	Text containing comment.	T	R

Field Name	***Description***	***Field Type***	***Count***
	Comment Record Size:		***12+R***

4.3.11 History record

The history record is intended to support automatic documentation of processing which has been applied to the data. It includes: the time the processing step occurred; the name of the operator; the name of the computer doing the processing; the program being used, along with any command line arguments or pertinent parameters; and a comment field is available for a summary of the processing that occurred when the program was run. Table 4-11 defines the format of a history record.

Table 4-11 History Record Definition

Field Name	***Description***	***Field Type***	***Count***
TIME	Time of processing action.	I	2*4
NAME_SIZE	Number of characters in computer's name (U).	I	2
MACHINE_TEXT	Name of computer on which processing occurs.	T	U
OPERATOR_SIZE	Number of characters in operator's name (V).	I	2
OPERATOR_TEXT	Name of operator performing the processing.	T	V
COMMAND_SIZE	Number of characters in command line (W).	I	2
COMMAND_TEXT	Command line used to run processing action.	T	W
COMMENT_SIZE	Number of characters in comment (X).	I	2

Field Name	Description	Field Type	Count
COMMENT_TEXT	Summary of processing action.	T	X
		History Record Size:	***16+U+V+W+X***

4.3.12 Navigation error record * obsolete, as of GSF v1.07*

(*This record is obsolete, as of GSF v1.07. The HV Navigation error record supersedes this record and should be used in its place.)*

This record contains estimates of the horizontal position error inherent in the latitude and longitude values in a given data record, along with the first time that the error estimates are valid. The record ID containing the position whose error is being estimated is also included so that a file containing different types of records, each of which contain position, may attribute error estimates for each record. Table 4-12 defines the format of a navigation error record.

Table 4-12 Navigation Error Record Definition

Field Name	Description	Field Type	Count
TIME	Time of error estimate validity.	I	2*4
RECORD_ID	Record ID to which the estimates applies	I	4
LONGITUDE_ERROR	Estimated error in decimeters, 95% CE.	I	4
LATITUDE_ERROR	Estimated error in decimeters, 95% CE.	I	4
		Navigation Error Record Size:	***20***

4.3.13 HV Navigation error record

This record supercedes that specified by the Navigation Error Record. This record contains estimates of the horizontal and vertical position error inherent in a given data record, along with the time that the error estimates are valid. The record ID containing the position whose error is being estimated is also included so that a file containing different types of records, each of which contain position, may attribute error estimates for each record. A variable length field specifies the positioning system that provides the error estimates. Refer to the GSFlib documentation – Supporting Data Structures and Definitions -- for a list of the available four character positioning system codes. Additionally, a field of four characters has been reserved for future use. Table 4-13 defines the format of a HV Navigation error record.

Table 4-13 HV Navigation Error Record Definition

Field Name	***Description***	***Field Type***	***Count***
TIME	Time of error estimate validity.	I	2*4
RECORD_ID	Record ID to which the estimates applies	I	4
HORIZONTAL_ERROR	RMS Errors in meters	I	4
VERTICAL_ERROR	RMS Errors in meters	I	4
SEP_UNCERTAINTY	RMS Error in meters of the separation uncertainty. This field defines the estimated uncertainty of the value that defines the separation from the reference ellipsoid to the chart datum.	I	2
SPARE	Reserved space, for future used	T	2
POSITION_TYPE_SIZE	Number of characters in position type (***v***)	I	2
POSITION_TYPE	Character String Code specifying type of positioning system	T	***v***
		Navigation Error Record Size:	***26 + v***

4.3.14 Attitude record

This record contains an array of measurements as reported by the vessel attitude sensor. This allows for the storage of every attitude measurement reported by the motion sensor. The attitude record consists of an integer value defining the number of measurements in the record, followed by arrays of time, pitch, roll, heave, and heading for each measurement. The number of measurements is variable and user-definable, but any single attitude record should contain no more than sixty seconds worth of measurements. Table 4-14 defines the format of an Attitude record.

Table 4-14 Attitude Record Definition

Field Name	***Description***	***Field Type***	***Count***
BASE_TIME	Full time of the first attitude measurement	I	2*4
NUM_MEASUREMENTS	Number of attitude measurements in this record (N).	I	2
ATTITUDE_TIME	Array of attitude measurement times, offset from the base time	I	N*2
PITCH	Array of pitch measurements	I	N*2
ROLL	Array of roll measurements	I	N*2
HEAVE	Array of heave measurements	T	N*2
HEADING	Array of heading measurements	T	N*2
		Attitude Record Size:	***Variable***

Appendix A.1 Record Identifier Definition

The record identifiers specified in this section define data records encoded in GSF. Record identifiers are recorded as decimal quantities.

Note that GSF data files may have records that have identifiers not described below; you may ignore records with undefined identifiers. This condition can occur because records with non-zero registry numbers are not defined within the formal specification. See section 4.3.1.2 for more information.

As of GSF v1.07 the NAVIGATION_ERROR record is obsolete. This record will remain as part of the GSF specification and the software library for the next few releases of GSF, allowing users of this record ample time to make the necessary software updates to migrate to the new record. New software releases should use the HV_NAVIGATION_ERROR record instead of the NAVIGATION_ERROR record.

Record Description		Record Identifier
HEADER		1
SWATH_BATHYMETRY_PING		2
SOUND_VELOCITY_PROFILE		3
PROCESSING_PARAMETERS		4
SENSOR_PARAMETERS		5
COMMENT		6
HISTORY		7
NAVIGATION_ERROR	*(obsolete)*	8
SWATH_BATHY_SUMMARY		9
SINGLE_BEAM_SOUNDING	*(use discouraged)*	10
HV_NAVIGATION_ERROR		11
ATTITUDE		12

Appendix A.2 Swath Bathymetry Ping Subrecord Identifier Definition

The subrecord identifiers specified in this section define data elements within the Swath Bathymetry Ping Records. Subrecord identifiers are recorded as decimal quantities.

Subrecord Description	Subrecord Identifier
DEPTH_ARRAY	1
ACROSS_TRACK_ARRAY	2
ALONG_TRACK_ARRAY	3
TRAVEL_TIME_ARRAY	4
BEAM_ANGLE_ARRAY	5
MEAN_CAL_AMPLITUDE_ARRAY	6
MEAN_REL_AMPLITUDE_ARRAY	7
ECHO_WIDTH_ARRAY	8
QUALITY_FACTOR_ARRAY	9
RECEIVE_HEAVE_ARRAY	10
DEPTH_ERROR_ARRAY (*obsolete*)	11
ACROSS_TRACK_ERROR_ARRAY (*obsolete*)	12
ALONG_TRACK_ERROR_ARRAY (*obsolete*)	13
NOMINAL_DEPTH_ARRAY	14
QUALITY_FLAGS_ARRAY	15
BEAM_FLAGS_ARRAY	16
SIGNAL_TO_NOISE_ARRAY	17
BEAM_ANGLE_FORWARD_ARRAY	18
VERTICAL_ERROR_ARRAY	19
HORIZONTAL_ERROR_ARRAY	20

Appendix A.3 Single-beam Sounding Subrecord Identifier Definition

The subrecord identifiers specified in this section define data elements within the single Beam Ping Records. Subrecord identifiers are recorded as decimal quantities. All of these single beam subrecords types are considered obsolete. Read support is maintained, but users are expected to encode single-beam data using the mb_ping record structure and specifying a number of beams value of 1.

Subrecord Description	Subrecord Identifier
ECHOTRAC_SPECIFIC	201
BATHY2000_SPECIFIC	202
MGD77_SPECIFIC	203
BDB_SPECIFIC	204
NOSHDB_SPECIFIC	205

Appendix B.1 Swath Bathymetry Ping Sensor-specific Subrecord Definitions

The sensor-specific subrecords are defined for use within the Swath Bathymetry Ping Records in Table B-1. Appendix A.2 defines subrecord identifiers for each subrecord. This specification does not provide detailed information about the data items within these subrecords. Use of these data requires a detailed knowledge of the sensor being used.

Table B-1 Swath Bathymetry Ping Sensor-specific Subrecord Definitions

Field Name	***Description***	***Field Type***	***Count***
SEABEAM ***Subrecord containing fields peculiar to SEABEAM sonar.***			*2*
ECLIPSE_TIME	Eclipse computer clock at time of ping.	U	2
KONGSBERG EM12 ***Subrecord containing fields particular to Kongsberg EM12 sonar.***			*39*
PING_NUMBER	Number assigned to the ping by the sonar	I	2
RESOLUTION	Indicates the resolution of data values	I	1
PING_QUALITY	Number of beams with accepted bottom detection	I	1
SOUND_VELOCITY	Sound velocity at transducer depth, either measured or set by the operator.	I	2
MODE	Defines if mode is shallow or deep and if beam spacing is equiangular or equidistant	I	1
SPARE	Reserved for future use	I	32

Field Name	***Description***	***Field Type***	***Count***
KONGSBERG EM100 ***Subrecord containing fields peculiar to Kongsberg EM100 sonar.***			*11*
SHIP_PITCH	Pitch of ship at ping time in 0.01 degree.	I	2
TRANSDUCER_PITCH	Angle of mechanical pitch stabilizer at ping time in 0.01 degree.	I	2
MODE	Description of sonar's mode.	I	1
POWER	Description of transmitter's power level.	I	1
ATTENUATION	Description of receiver's attenuation level.	I	1
TVG	Description of receiver's time-varying gain curve.	I	1
PULSE_LENGTH	Description of transmitted pulse length.	I	1
COUNTER	Ping counter from Kongsberg amplitude datagram	I	2
KONGSBERG EM950 ***Subrecord containing fields peculiar to Kongsberg EM950 sonar.***			*10*
PING_NUMBER	Number assigned to ping by sonar.	U	2
MODE	Description of sonar's mode.	U	1
QUALITY	Description of ping quality.	U	1
SHIP_PITCH	Pitch of ship at ping time in hundredths of degrees.	I	2

Field Name	***Description***	***Field Type***	***Count***
TRANSDUCER_PITCH	Angle of mechanical pitch stabilizer at ping time in hundredths of degrees.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	U	2
KONGSBERG EM1000 ***Subrecord containing fields peculiar to Kongsberg EM1000 sonar.***			*10*
PING_NUMBER	Number assigned to ping by sonar.	I	2
MODE	Description of sonar's mode.	I	1
QUALITY	Description of ping quality.	I	1
SHIP_PITCH	Pitch of ship at ping time in hundredths of degrees.	I	2
TRANSDUCER_PITCH	Angle of mechanical pitch stabilizer at ping time in hundredths of degrees.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
KONGSBERG EM121 ***Subrecord containing fields peculiar to Kongsberg EM121 sonar.***			*11*
PING_NUMBER	Number assigned to ping by sonar.	I	2
MODE	Description of sonar's mode.	I	1
VALID_BEAMS	Number of valid beams in ping.	I	1

Field Name	*Description*	*Field Type*	*Count*
PULSE_LENGTH	Description of transmitted pulse length.	I	1
BEAM_WIDTH	Description of receive beam width.	I	1
TRANSMIT_POWER	Description of transmitter's power level.	I	1
TRANSMIT_STATUS	Number of transmit channels not working.	I	1
RECEIVE_STATUS	Number of receive channels not working.	I	1
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
KONGSBERG EM121A ***Subrecord containing fields peculiar to Kongsberg EM121A sonar.***			*11*
PING_NUMBER	Number assigned to ping by sonar.	I	2
MODE	Description of sonar's mode.	I	1
VALID_BEAMS	Number of valid beams in ping.	I	1
PULSE_LENGTH	Description of transmitted pulse length.	I	1
BEAM_WIDTH	Description of receive beam width.	I	1
TRANSMIT_POWER	Description of transmitter's power level.	I	1
TRANSMIT_STATUS	Number of transmit channels not working.	I	1

Field Name	*Description*	*Field Type*	*Count*
RECEIVE_STATUS	Number of receive channels not working.	I	1
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
KONGSBERG EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS ***Subrecord containing fields particular to Kongsberg EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS series sonars.***			*21+49*L*
MODEL_NUMBER	Model number of Kongsberg sensor acquiring ping data.	I	2
PING_NUMBER	Number assigned to ping by sonar.	I	2
SERIAL_NUMBER	Serial number of multibeam sonar.	I	2
SURFACE_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
TRANSDUCER_DEPTH	Depth of transducer (transmit depth) in centimeters.	I	2
VALID_BEAMS	Number of valid beams in ping.	I	2
SAMPLE_RATE	Sampling rate (f) in Hz.	I	2
DEPTH_DIFFERENCE	Depth difference between sonar heads of the EM3000D in centimeters.	I	2
OFFSET_MULTIPLIER	Transducer depth offset multiplier	I	1
RUN_TIME_ID	Indicates existence and number of EM3000 series specific run-time parameter arrays (L) in subrecord. Bit 0 set (value of 1) indicates only	I	4

Field Name	Description	Field Type	Count
	one set of run-time parameters are included in the subrecord -- used for single headed sonar system. Bit 1 set (value of 2) indicates two sets of run-time parameters complete the subrecord -- used for the EM3000D series sonar (dual headed) systems. If bit 1 is set, the first element of the array represents the port transducer head while the second array element represents the starboard transducer head.		
RUN_TIME_MODEL_NUMBER(1)	Model number for sonar head	I	2
RUN_TIME_SECONDS(1)	Time at start of data record, in whole seconds since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_NANOSECONDS(1)	Time at start of data record, an additional fractional portion of whole seconds expressed in nanoseconds, since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_PING_NUMBER(1)	Number assigned to ping by sonar	I	2
RUN_TIME_SERIAL_NUMBER(1)	Serial number assigned to sonar head	I	2
RUN_TIME_SYSTEM_STATUS(1)	Identifier describing system status	I	4
RUN_TIME_MODE(1)	Identifier describing sonar mode	I	1
RUN_TIME_FILTER_ID(1)	Identifier describing sonar filter	I	1

Field Name	***Description***	***Field Type***	***Count***
RUN_TIME_MIN_DEPTH(1)	Minimum depth setting in meters	I	2
RUN_TIME_MAX_DEPTH(1)	Maximum depth setting in meters	I	2
RUN_TIME_ABSORPTION(1)	Absorption coefficient in hundredths of dB/km	I	2
RUN_TIME_PULSE_LENGTH(1)	Transmit pulse length in microseconds	I	2
RUN_TIME_TRANSMIT_BEAM_WIDTH(1)	Transmit beam width in tenths of degrees	I	2
RUN_TIME_POWER_REDUCTION(1)	Transmit power reduction in dB	I	1
RUN_TIME_RECEIVE_BEAM_WIDTH(1)	Receive beamwidth in tenths of degrees	I	1
RUN_TIME_RECEIVE_BANDWIDTH(1)	Receive bandwidth in fifty Hz resolution	I	1
RUN_TIME_RECEIVE_GAIN(1)	Receiver fixed gain setting in dB	I	1
RUN_TIME_CROSS_OVER_ANGLE(1)	TVG law crossover angle in degrees	I	1
RUN_TIME_SSV_SOURCE(1)	Source of sound speed at transducer	I	1
RUN_TIME_PORT_SWATH_WIDTH(1)	Maximum port swath width in meters	I	2
RUN_TIME_BEAM_SPACING(1)	Beam Spacing	I	1
RUN_TIME_PORT_COVERAGE_SECTOR(1)	Port coverage sector in degrees	I	1
RUN_TIME_STABILIZATION(1)	Yaw and pitch stabilization mode	I	1
RUN_TIME_STBD_COVERAGE_SECTOR(1)	Starboard coverage sector in degrees	I	1

Field Name	***Description***	***Field Type***	***Count***
RUN_TIME_STBD_SWATH_WIDTH(1)	Maximum starboard swath width in meters	I	2
RUN_TIME_HILO_FREQ_ABSORP_RATIO(1)	HiLo frequency absorption coefficient ratio	I	1
RUN_TIME_SPARE(1)	Reserved for future use.	I	4
RUN_TIME_MODEL_NUMBER(2)	Model number for sonar head	I	2
RUN_TIME_SECONDS(2)	Time at start of data record, in whole seconds since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_NANOSECONDS(2)	Time at start of data record, an additional fractional portion of whole seconds expressed in nanoseconds, since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_PING_NUMBER(2)	Number assigned to ping by sonar	I	2
RUN_TIME_SERIAL_NUMBER(2)	Serial number assigned to sonar head	I	2
RUN_TIME_SYSTEM_STATUS(2)	Identifier describing system status	I	4
RUN_TIME_MODE(2)	Identifier describing sonar mode	I	1
RUN_TIME_FILTER_ID(2)	Identifier describing sonar filter	I	1
RUN_TIME_MIN_DEPTH(2)	Minimum depth setting in meters	I	2
RUN_TIME_MAX_DEPTH(2)	Maximum depth setting in meters	I	2
RUN_TIME_ABSORPTION(2)	Absorption coefficient in hundredths of dB/km	I	2

Field Name	Description	Field Type	Count
RUN_TIME_PULSE_LENGTH(2)	Transmit pulse length in microseconds	I	2
RUN_TIME_TRANSMIT_BEAM_WIDTH(2)	Transmit beam width in tenths of degrees	I	2
RUN_TIME_POWER_REDUCTION(2)	Transmit power reduction in dB	I	1
RUN_TIME_RECEIVE_BEAM_WIDTH(2)	Receive beamwidth in tenths of degrees	I	1
RUN_TIME_RECEIVE_BANDWIDTH(2)	Receive bandwidth in fifty Hz resolution	I	1
RUN_TIME_RECEIVE_GAIN(2)	Receiver fixed gain setting in dB	I	1
RUN_TIME_CROSS_OVER_ANGLE(2)	TVG law crossover angle in degrees	I	1
RUN_TIME_SSV_SOURCE(2)	Source of sound speed at transducer	I	1
RUN_TIME_PORT_SWATH_WIDTH(2)	Maximum port swath width in meters	I	2
RUN_TIME_BEAM_SPACING(2)	Beam Spacing	I	1
RUN_TIME_PORT_COVERAGE_SECTOR(2)	Port coverage sector in degrees	I	1
RUN_TIME_STABILIZATION(2)	Yaw and pitch stabilization mode	I	1
RUN_TIME_STBD_COVERAGE_SECTOR(2)	Starboard coverage sector in degrees	I	1
RUN_TIME_STBD_SWATH_WIDTH(2)	Maximum starboard swath width in meters	I	2
RUN_TIME_HILO_FREQ_ABSORP_RATIO(2)	HiLo frequency absorption coefficient ratio	I	1
RUN_TIME_SPARE(2)	Reserved for future use.	I	4

Field Name	*Description*	*Field Type*	*Count*
KONGSBERG EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS ***Data collected using the raw range and beam angle datagram.*** ***Subrecord containing fields specific to Kongsberg EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS series sonars.***			*63 + Ntx*38 + 63 +23*
MODEL_NUMBER	Model number of Kongsberg sensor acquiring ping data.	I	2
PING_COUNTER	Number assigned to ping by sonar.	I	2
SERIAL_NUMBER	Serial number of multibeam sonar.	I	2
SURFACE_VELOCITY	Surface sound velocity at transducer used to calculate beam angle in tenths of meters/seconds.	I	2
TRANSDUCER_DEPTH	Depth of transducer (transmit depth) in centimeters. (from 0x44)	I	4
VALID_DETECTIONS	Number of beams with a valid detection for this ping.	I	2
SAMPLING_FREQUENCY	Sampling rate (f) in 0.01 Hz.	I	8
VECHICLE_DEPTH	From 0x66 datagram, non-zero when sonar head is mounted on a sub-sea platform in 0.001 meters.	I	4
DEPTH_DIFFERENCE	Difference between sonar heads in a EM3000D or EM3002D	I	2
OFFSET_MULTIPLIER	Transducer depth offset multiplier	I	1
SPARE_1		I	16
TRANSMIT_SECTORS (Number Sectors)	The number of transmit sectors for this ping (*Ntx)*	I	2

Field Name	***Description***	***Field Type***	***Count***
Number Sector entries of:	Array of structures with transmit sector information, cycle repeats for each sector.		
Tilt Angle	The transmitter title angle in degrees.	I	2
Focus Range	The focusing range in meters. 0.0 for no focusing.	I	2
Signal Length	The transmit signal duration in seconds.	I	4
Transmit Delay	The sector transmit delay from the first transmission in seconds.	I	4
Center Frequency	The center frequency in Hz.	I	4
Waveform ID	The signal waveform ID (0=CW, 1=FM upsweep, 2=FM downsweep)	I	1
Sector Number	The transmit sector number	I	1
Signal Bandwidth	The signal Bandwidth in Hz.	I	4
Spare	Spare space reserved for future use.	I	16
SPARE_2	Spare space reserved for future use.	I	16
RUN_TIME_MODEL_NUMBER	Model number for sonar head	I	2
RUN_TIME_SECONDS	Time at start of data record, in whole seconds since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_NANOSECONDS	Time at start of data record, an additional fractional portion of	I	4

Field Name	Description	Field Type	Count
	whole seconds expressed in nanoseconds, since 00:00:00 Coordinated Universal Time, January 1, 1970.		
RUN_TIME_PING_COUNTER	Number assigned to ping by sonar	I	2
RUN_TIME_SERIAL_NUMBER	Serial number assigned to sonar head	I	2
RUN_TIME_OPERATOR_STATION_STATUS	Bit mask of status information for operator station.	I	1
RUN_TIME_PROCESSING_UNIT_STATUS	Bit mask of status information for processing unit.	I	1
RUN_TIME_BSP_STATUS	Bit mask of status for BSP.	I	1
RUN_TIME_HEAD_TRANSCEIVER_STATUS	Bit mask of status for sonar transceiver.	I	1
RUN_TIME_MODE	Identifier describing sonar mode	I	1
RUN_TIME_FILTER_ID	Identifier describing sonar filter	I	1
RUN_TIME_MIN_DEPTH	Minimum depth setting in meters	I	2
RUN_TIME_MAX_DEPTH	Maximum depth setting in meters	I	2
RUN_TIME_ABSORPTION	Absorption coefficient in hundredths of dB/km	I	2
RUN_TIME_PULSE_LENGTH	Transmit pulse length in microseconds	I	2
RUN_TIME_TRANSMIT_BEAM_WIDTH	Transmit beam width in tenths of degrees	U	2
RUN_TIME_POWER_REDUCTION	Transmit power reduction in dB	U	1

Field Name	***Description***	***Field Type***	***Count***
RUN_TIME_RECEIVE_BEAM_WIDTH	Receive beam width in tenths of degrees	U	1
RUN_TIME_RECEIVE_BANDWIDTH	Receive bandwidth in fifty Hz resolution	I	1
RUN_TIME_RECEIVE_GAIN	Receiver fixed gain setting in dB	I	1
RUN_TIME_CROSS_OVER_ANGLE	TVG law crossover angle in degrees	I	1
RUN_TIME_SSV_SOURCE	Source of sound speed at transducer	I	1
RUN_TIME_PORT_SWATH_WIDTH	Maximum port swath width in meters	I	2
RUN_TIME_BEAM_SPACING	Beam Spacing	I	1
RUN_TIME_PORT_COVERAGE_SECTOR	Port coverage sector in degrees	I	1
RUN_TIME_STABILIZATION	Yaw and pitch stabilization mode	I	1
RUN_TIME_STBD_COVERAGE_SECTOR	Starboard coverage sector in degrees	I	1
RUN_TIME_STBD_SWATH_WIDTH	Maximum starboard swath width in meters	I	2
RUN_TIME_DUROTONG_SPEED	Outer beam angle coverage correction value for EM1002. This field is considered undefined for systems other than the EM1002.	I	2
RUN_TIME_HILO_FREQ_ABSORP_RATIO	HiLo frequency absorption coefficient ratio	I	1
RUN_TIME_SPARE	Reserved for future use.	I	16
PU_CPU_LOAD	Percent CPU load in the processor unit	I	1

Field Name	Description	Field Type	Count
SENSOR_STATUS	Bit mask containing status of sensor inputs	U	2
ACHIVED_PORT_COVERAGE	Achieved coverage to port in degrees	I	1
ACHIEVED_STDB_COVERAGE	Achieved coverage to starboard in degrees	I	1
YAW_STABILIZATION	Yaw stabilization in degrees	I	2
SPARE	Reserved for future use	I	16
KONGSBERG KMALL Systems ***Data collected using the MRZ datagram.***			221+NTx*64+Nxd*35
gsfKMALLVersion	Subrecord Version Number	U	1
dgmType	a one byte integer value: 1 = #MRZ	U	1
dgmVersion	a one byte integer value	U	1
systemID	parameter used to identify datagrams from separate echosounders when multiple echosounders are connected	U	1
echoSounderID	122, 302, 710, 712, 2040,	U	2
spare1		U	8
numBytesCmnPart	Size of cmnPart	U	2
pingCnt	Sequential ping counter, 1 through 65535	U	2
rxFansPerPing	Number of rx fans per ping, together with swaths per ping	U	1

Field Name	***Description***	***Field Type***	***Count***
	determines number of datagrams per swath		
rxFanIndex	Index of rx fan, 0 = aft, port swath	U	1
swathsPerPing	Swaths per ping, swath is a complete set of across track data, may contain several transmit sectors and RX fans	U	1
swathAlongPosition	Alongship index for swath in multi-swath mode, 0 = aftmost	U	1
txTransducerInd	Transducer used in this rx fan: 0 = TRAI_TX1, 1 = TRAI_TX2, ...	U	1
rxTransducerInd	Transducer used in this rx fan: 0 = TRAI_RX1, 1 = TRAI_RX2, ...	U	1
numRxTransducers	Total number of recieving units	U	1
algorithmType	Future use. 0 = current, else future	U	1
spare2		U	16
numBytesInfoData	Size of ping info structure	U	2
pingRate_Hz	Ping rate computed by the sonar	U	4
beamSpacing	0 = Equidistance, 1 = Equiangle, 2 = High Density	U	1
depthMode	0 = Very shallow, 1 = Shallow, 2 = Medium, 3 = Deep, 4 = Deeper, 5 = Very Deep, 6 = Extra Deep, 7 = Extreme deep	U	1
subDepthMode	Advanced use for manual depth mode, 0 = unused	U	1

Field Name	***Description***	***Field Type***	***Count***
distanceBtwSwath	achieved distance between swaths as percentage of requirement: 0=unused, 100=achieved equals required	U	1
detectionMode	Bottom detection: 0 = normal, 1 = waterway, 2 = tracking, 3 = minimum depth	U	1
pulseForm	0 = CW, 1 = mix, 2 = FM	U	1
frequencyMode_Hz	A code if < 100, otherwise the transmit frequency Hz. Codes: -1 = not used, 0 = 40-100 khz, 1 = 50-100khz, 2 = 70-100khz, 3 = 50khz, 4 = 40khz	I	4
freqRangeLowLim_Hz	In hertz, lowest center frequency of swath's sectors	I	4
freqRangeHighLim_Hz	In hertz, highest center frequency of swath's sectors	I	4
maxTotalTxPulseLength_sec	In seconds, longest tx pulse of swath's sectors	I	4
maxEffTxPulseLength_sec	In seconds, longest effective tx pulse of swath's sectors	I	4
maxEffTxBandWidth_Hz	Effective bandwidth (-3dB envelope) of the sector with the highest bandwidth	I	4
absCoeff_dBPerkm	Average absorption coefficient, in dB/km for vertical beam at current depth	I	4

Field Name	***Description***	***Field Type***	***Count***
portSectorEdge_deg	Port sector edge, for use by beamformer, referenced to z of SCS	I	2
starbSectorEdge_deg	Starboard sector edge, for use by beamformer, referenced to z of SCS	I	2
portMeanCov_deg	Coverage achieved in degrees, corrected for raybending, referenced to z of SCS	I	2
starbMeanCov_deg	Coverage achieved in degrees, corrected for raybending, referenced to z of SCS	I	2
portMeanCov_m	Coverage achieved in meters, corrected for raybending, referenced to z of SCS	I	2
starbMeanCov_m	Coverage achieved in meters, corrected for raybending, referenced to z of SCS	I	2
modeAndStabilisation	Bit mask: 1 = Pitch, 2 = yaw, 3 = sonar mode, 4 = angular converage mode, 5 = sector mode, 6 = swath along position, 7 & 8 = future use	U	1
runtimeFilter1	Bit mask: 1 = Slope, 2 = Aeration, 3 = Sector, 4 = Interference, 5 = Special Amplitude, 6 - 8 = future use	U	1
runtimeFilter2	Bit mask: 1-4 = range gate, 5-8 = spike filter, 9-12 penetration filter, 13-16 phase ramp	U	2

Field Name	Description	Field Type	Count
pipeTrackingStatus	Pipe tracking status. Describes how angle and range of top of pipe is determined. 0 = for future use, 1 = PU uses guidance from SIS	U	4
transmitArraySizeUsed_deg	degrees, transmit array size along ship	U	2
receiveArraySizeUsed_deg	degrees, receiver array size across ship	U	2
transmitPower_dB	dB, transmit power relative to maximum (0 dB, -10 dB, -20 dB ...)	I	2
SLrampUpTimeRemaining	percentage, time remaining until max source level is achieved	U	2
yawAngle_deg	degrees, yaw correction angle	I	4
numTxSectors (Number Sectors)	The number of transmit sectors for this ping (*Ntx)*	I	2
numBytesPerTxSector	Number of bytes in the EMdgmMRZ_txSectorInfo	U	2
headingVessel_deg	Degrees, Heading of vessel at time of midpoint of first tx pulse	I	4
soundSpeedAtTxDepth_mPerSec	Measured sound speed at the transducer depth in m/s at time of midpoint of first tx pulse, (Source set in K-controller)	I	4
txTransducerDepth_m	meters, the transmit transducer depth in meters re water level at time of midpoint of first tx pulse	I	4

Field Name	***Description***	***Field Type***	***Count***
z_waterLevelReRefPoint_m	meters, the vertical distance between the waterline and vessel reference point, measured in SCS	I	4
x_kmallToall_m	meters, distance between *.all reference point and *.kmall reference point, measured in SCS	I	4
y_kmallToall_m	meters, distance between *.all reference point and *.kmall reference point, measured in SCS	I	4
latLongInfo	Sensor Position data method: 0 = last position received, 1 = interpolated, 2 = processed	U	1
posSensorStatus	Position sensor status 0 = valid data, 1 = invalid data, 2 = reduced performance	U	1
attitudeSensorStatus	Attitude sensor status 0 = valid data, 1 = invalid data, 2 = reduced performance	U	1
latitude_deg	decimal degrees, location of vessel reference point reported by sensor, determined by method in lat_lon_info	I	4
longitude_deg	decimal degrees, location of vessel reference point reported by sensor, determined by method in lat_lon_info	I	4
ellipsoidHeightReRefPoint_m	meters, height of vessel reference point above ellipsoid, derived from active GGA sensor	I	4

Field Name	***Description***	***Field Type***	***Count***
spare3		U	32
Number Sector entries of:	**Array of structures with transmit sector information, cycle repeats for each sector.**		
txSectorNumb	Transmit sector number	U	1
txArrNumber	Transmit array number	U	1
txSubArray	Transmit sub-array number: 0 = Port, 1 = Middle, 2 = Starboard	U	1
sectorTransmitDelay_sec	Seconds, time difference of midpoint of current tx pulse over first tx pulse of ping	U	4
tiltAngleReTx_deg	Transmitted beam angle along ship steering angle wrt. transmitter coordinate system	I	4
txNominalSourceLevel_dB	decibels, relative 1 microPascal	I	4
txFocusRange_m	meters, 0 = no focusing applied	U	4
centreFreq_Hz	Hertz, center frequency	U	4
signalBandWidth_Hz	Hertz, FM mode: effective bandwidth, CW mode: 1/(effective tx pulse length)	U	4
totalSignalLength_sec	seconds, transmit pulse length	U	4
pulseShading	Percent amplitude shading. Shading in time. Cos2 function used for shading	U	1
signalWaveForm	0 = CW, 1 = FM upsweep, 2 = FM downsweep	U	1
HighVoltageLevel_dB	Voltage level in decibels	U	4

Field Name	Description	Field Type	Count
sectorTrackingCorr_dB	Sector tracking correction in decibels	U	4
effectiveSignalLenth_sec	Effective Signal Length in seconds	U	4
Spare1		U	8
END NUMBER SECTOR ENTRIES			
numBytesRxInfo	Size of the rxInfo structure portion of the datagram	U	2
numSoundingsMaxMain	Number of beams (valid and non valid) recorded in sounding array	U	2
numSoundingsValidMain	Number of beams with a valid bottom detection for this ping	U	2
numBytesPerSounding	Bytes per loop of soundings	U	2
WCSampleRate	The system digitizing rate in Hz, value retrieved from the imagery datagram	U	4
seabedImageSampleRate	Sample frequency divided by seabed image decimation factor in hertz (divided into integer and fractional portion U 4s)	U	2*4
BSnormal_dB	normal incidence BS in dB	I	4
BSoblique_dB	oblique incidence BS in dB	I	4
extraDetectionAlarmFlag	sum of alarm flags from extra detections	U	2
numExtraDetections	The number of extra detections (soundings in water column)	U	2

Field Name	***Description***	***Field Type***	***Count***
numExtraDetectionClasses	The number of extra detection classes (Nxd)	U	2
numBytesPerClass	Size of the extra detection class		2
Spare4		U	32
Extra Detection Class entries of:	**Array of structures with extra detection info, cycle repeats for each extra detection class (Nxd).**		
numExtraDetInClass	number of extra detections of this class	U	2
alarmFlag	0 = no alarm, 1 = alarm	U	1
Spare		U	32
End Extra Detection Class entries			
Spare5		U	32
SEAMAP ***Subrecord containing fields peculiar to Seamap sonar.***			*22*
PORT_TRANSMIT_1	Level of first port transmitter.	I	2
PORT_TRANSMIT_2	Level of second port transmitter.	I	2
STBD_TRANSMIT_1	Level of first starboard transmitter.	I	2
STBD_TRANSMIT_2	Level of second starboard transmitter.	I	2
PORT_GAIN	Gain of port receive channel, in tenths of decibels.	I	2
STBD_GAIN	Gain of starboard receive channel, in tenths of decibels.	I	2

Field Name	***Description***	***Field Type***	***Count***
PORT_PULSE_LENGTH	Length of port transmission, in tenths of seconds.	I	2
STBD_PULSE_LENGTH	Length of starboard transmission, in tenths of seconds.	I	2
PRESSURE_DEPTH	Depth measured by pressure sensor, in tenths of meters. (Note: this value is only available in GSF versions 2.08 and greater.)	I	2
ALTITUDE	Distance of tow body from seafloor, in tenths of meters.	I	2
TEMPERATURE	Temperature at tow body location, in tenths of degrees Centigrade.	I	2
SEABAT 9000 ***Subrecord containing fields peculiar to RESON SeaBat 9000 Series sonars.*** ***Obsolete; see SEABAT 9000 II Subrecord.***			*8*
PING_NUMBER	Number assigned to ping by sonar.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
MODE	Description of sonar mode setting.	I	1
RANGE	Description of sonar range setting.	I	1
TRANSMIT_POWER	Description of transmitter's power level.	I	1
RECEIVE_GAIN	Description of receiver's gain setting.	I	1

Field Name	***Description***	***Field Type***	***Count***
SEABEAM with Amplitude ***Subrecord containing fields peculiar to SEABEAM sonar with amplitude beam values.***			*10*
HOUR	Hour of Eclipse computer clock at time of ping.	I	1
MINUTE	Minute of Eclipse computer clock at time of ping	I	1
SECOND	Seconds of Eclipse computer clock at time of ping	I	1
HUNDREDTHS	Hundredths of seconds of Eclipse computer clock at time of ping	I	1
BLOCK_NUMBER	Block number	I	4
AVG_GATE_DEPTH	Average Depth of Bottom Gate	I	2
SEABAT 9000 II ***Subrecord containing fields peculiar to RESON SeaBat 9000 Series sonars. First SEABAT 9000 Subrecord is obsolete.***			*18*
PING_NUMBER	Number assigned to ping by sonar.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
MODE	Description of sonar mode setting.	I	2
RANGE	Description of sonar range setting.	I	2
TRANSMIT_POWER	Description of transmitter's power level.	I	2
RECEIVE_GAIN	Description of receiver's gain setting.	I	2

Field Name	***Description***	***Field Type***	***Count***
TRANSMIT_BEAMWIDTH	Transmit beam width, in tenths of degrees.	I	1
RECEIVE_BEAMWIDTH	Receive array beam width, in tenths of degrees.	I	1
RESERVED	Reserved for future use	I	4
SEABAT 8101 ***Subrecord containing fields peculiar to RESON SeaBat 8101 Series sonars.*** ***Obsolete. See Reson 8100 subrecord.***			*31*
PING_NUMBER	Number assigned to ping by sonar.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
MODE	Description of sonar mode setting.	I	2
RANGE	Description of sonar range setting.	I	2
TRANSMIT_POWER	Description of transmitter's power level.	I	2
RECEIVE_GAIN	Description of receiver's gain setting.	I	2
PULSE_WIDTH	Transmit pulse width	I	2
TVG_SPREADING	TVG spreading coefficient	I	1
TVG_ABSORPTION	TVG absorption coefficient	I	1
TRANSMIT_BEAMWIDTH	Transmit beam width, in tenths of degrees.	I	1
RECEIVE_BEAMWIDTH	Receive array beam width, in tenths of degrees.	I	1

Field Name	***Description***	***Field Type***	***Count***
RANGE_FILTER_MINIMUM	Range filters minimum value in meters.	I	2
RANGE_FILTER_MAXIMUM	Range filter maximum value in meters.	I	2
DEPTH_FILTER_MINIMUM	Depth filter minimum value in meters.	I	2
DEPTH_FILTER_MAXIMUM	Depth filter maximum value in meters.	I	2
PROJECTOR_TYPE	Type of projector used for transmission	I	1
RESERVED	Reserved for future use	I	4
SEABEAM 2112 ***Subrecord containing fields peculiar to SEABEAM 2112 sonars.***			*14*
MODE	Sonar mode of operation	I	1
SURFACE_SOUND_VELOCITY	Surface sound velocity in hundredths of meters/second	I	2
SSSV_SOURCE	Source of surface sound velocity	I	1
PING_GAIN	Ping gain	I	1
PULSE_WIDTH	Ping pulse width	I	1
TRANSMITTER_ATTENUATION	Transmitter attenuation	I	1
NUMBER_ALGORITHMS	Number of algorithms in use.	I	1
ALGORITHM_ORDER	Order of algorithm use.	I	4
RESERVED	Reserved	I	2

Field Name	Description	Field Type	Count
ELAC MKII **Subrecord containing fields peculiar to ELAC BottomChart MkII sonar.**			11
MODE	Sonar mode of operation	I	1
COUNTER	Ping counter	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity in meters/sec.	I	2
PULSE_LENGTH	Transmit pulse length in hundredth of seconds.	I	2
RECEIVER_GAIN_STBD	Starboard transceiver receive gain in decibels	I	1
RECEIVER_GAIN_PORT	Port transceiver receive gain in decibels	I	1
RESERVED	Reserved	I	2
TYPEIII SASS **Subrecord containing fields peculiar to SASS TypeIII data. This subrecord will be replaced by the COMPRESSED SASS subrecord. Future releases should use the COMPRESSED SASS subrecord.**			12
LEFTMOST_BEAM	Leftmost beam of sonar ping	I	2
RIGHTMOST_BEAM	Rightmost beam of sonar ping	I	2
TOTAL_NUMBER_OF_BEAMS	Number of beams in ping	I	2
NAVIGATION_MODE	Description of sonar's navigation mode	I	2
PING_NUMBER	Number assigned to ping by sonar	I	2
MISSION_NUMBER	Mission number assigned to ping	I	2

Field Name	***Description***	***Field Type***	***Count***
COMPRESSED SASS (BOSDATA) ***Subrecord containing fields peculiar to the SASS*YERG Compressed Data Format. This format may contain SASS, SASS IV, SASS V, NAVO Seabeam, BTOSS or Kongsberg Sonar Data.***			*4*
LFREQ	Sea surface sound velocity in tenths of feet/second, from BOSDAT (lfreq)	I	2
LNTENS	Since 1992, used to record heave value for ping in tenths of meters; prior to 1992, the content of this field is undocumented.	I	2
RESON 7100 **Subrecord containing fields peculiar to RESON SeaBat 7100 Series sonars. This format may contain data from an 7125 sonar**			*186*
PROTOCOL_VERSION	Protocol version defined in the Data Record Frame (DRF)	U	2
DEVICE_ID	The model number of the sonar (i.e. 7101, 7111, 7125, etc.) Obtained from the DRF	U	4
RESERVED	Placeholder for growth of fields from DRF	U	16
MAJOR_SERIAL_NUMBER	high order 4 bytes of sonar serial number, from 7K Sonar Settings Record (7000)	U	4
MINOR_SERIAL_NUMBER	low order 4 bytes of sonar serial number, from record 7000	U	4
PING_NUMBER	sequential number, unique for each ping, wraps at boundary	U	4

Field Name	***Description***	***Field Type***	***Count***
MULTI_PING_SEQ	0 if not in multi-ping mode, otherwise number of pings in a multi-ping sequence	U	2
FREQUENCY	Sonar operating frequency in Hz. From record 7000	U	4
SAMPLE_RATE	Sonar system sampling rate in Hz. From record 7000	U	4
RECEIVER_BANDWIDTH	Sonar system signal bandwidth in Hz. From record 7000	U	4
TX_PULSE_WIDTH	Transmit pulse length in seconds. From record 7000	U	4
TX_PULSE_TYPE_ID	0=CW, 1=Linear chirp, from record 7000	U	4
TX_PULSE_ENVLP_ID	0=Tapered rectangular, 1=Tukey, from record 7000	U	4
TX_PULSE_ENVLP_PARAM	four byte field containing envelope parameter, no definition or units available, from record 7000	U	4
TX_PULSE_RESERVED	four byte field reserved for future growth, from record 7000	U	4
MAX_PING_RATE	Maximum ping rate in pings per second, from record 7000	U	4
PING_PERIOD	seconds since last ping, from record 7000	U	4
RANGE	Sonar range selection in meters, from record 7000	U	4

Field Name	***Description***	***Field Type***	***Count***
POWER	Power selection in dB re 1 microPa, from record 7000	U	4
GAIN	Gain selection in dB, from record 7000	U	4
CONTROL_FLAGS	0-3: Auto range method 4-7: Auto bottom detect filter method 8: Bottom detect range filter 9: Bottom detect depth filter 10-14: Auto receiver gain method 15-31: Reserved	U	4
PROJECTOR_ID	Projector selection, from record 7000	U	4
PROJECTOR_STEER_ANGL_VERT	Projector beam steering angle vertical in degrees, from record 7000	U	4
PROJECTOR_STEER_ANGL_HORZ	Projector beam steering angle horizontal in degrees, from record 7000	U	4
PROJECTOR_BEAM_WDTH_VERT	Projector beam width vertical in degrees, from record 7000	U	2
PROJECTOR_BEAM_WDTH_HORZ	Projector beam width horizontal in degrees, from record 7000	U	2
PROJECTOR_BEAM_FOCAL_PT	Projector beam focal point in meters, from record 7000	U	4
PROJECTOR_BEAM_WEIGHTING_WINDOW_TYPE	0-Rectangular, 1-Chebychhev, from record 7000	U	4

Field Name	*Description*	*Field Type*	*Count*
PROJECTOR_BEAM_WEIGHTING_WINDOW_PARAM	four byte projector weighting parameter, no definition or units available, from record 7000	U	4
TRANSMIT_FLAGS	0-3: Pitch stabilization method 4-6: Yaw stabilization method 8-31: Reserved	U	4
HYDROPHONE_ID	hydrophone selection, from record 7000	U	4
RECEIVING_BEAM_WEIGHTING_WINDOW_TYPE	0-Chebychev, 1-Kaiser, from record 7000	U	4
RECEIVING_BEAM_WEIGHTING_WINDOW_PARAM	four byte receiver weighting parameter, no definition or units available, from record 7000	U	4
RECEIVE_FLAGS	0-3: Roll stabilization method 4-7: Dynamic focusing method 8-11: Doppler compensation method 12-15: Match filtering method 16-19: TVG method 20-23: Multi-Ping Mode 24-31: Reserved	U	4
RECEIVE_BEAM_WIDTH	angle in degrees, from record 7000	U	2
RANGE_FILT_MIN	range filter, minimum value, meters, from record 7000	U	2

Field Name	***Description***	***Field Type***	***Count***
RANGE_FILT_MAX	range filter, maximum value, meters, from record 7000	U	2
DEPTH_FILT_MIN	depth filter, minimum value, meters, from record 7000	U	2
DEPTH_FILT_MAX	depth filter, maximum value, meters, from record 7000	U	2
ABSORPTION	absorption in dB/km, from record 7000	U	4
SOUND_VELOCITY	sound speed in m/s at transducer, from record 7000	U	2
SPREADING	spreading loss in dB from record 7000	U	4
RAW_DATA_FROM_7027	Source of beam angles and travel times (0: from 7004/7006 record, 1: from 7027 record)	U	1
RESERVED	spare space, for future use	U	15
SV_SOURCE	(0: measured, 1: manual), from 7K Bathymetric Data Record (7006)	U	1
LAYER_COMP_FLAG	(0: off, 1: on), from record 7006	U	1
RESERVED	spare space, for future use	U	8
RESON T Series **Subrecord containing fields peculiar to RESON SeaBat T Series sonars. This format may contain data from a T20 or T50 sonar**			*707*
PROTOCOL_VERSION	Protocol version defined in the Data Record Frame (DRF)	U	2

Field Name	***Description***	***Field Type***	***Count***
DEVICE_ID	The model number of the sonar (i.e. 7101, 7111, 7125, 20, 50, etc.) Obtained from the DRF	U	4
NUMBER_DEVICES	Number of devices / sonars, from record 7001	U	4
SYSTEM_ENUMERATOR	Enumerator used to differentiate between devices with the same device identifiers in one system	U	2
RESERVED	Spare space, for future use	U	10
MAJOR_SERIAL_NUMBER	high order 4 bytes of sonar serial number, from 7K Sonar Settings Record (7000)	U	4
MINOR_SERIAL_NUMBER	low order 4 bytes of sonar serial number, from record 7000	U	4
PING_NUMBER	sequential number, unique for each ping, wraps at boundary, from record 7027	U	4
MULTI_PING_SEQ	0 if not in multi-ping mode, otherwise number of pings in a multi-ping sequence	U	2
FREQUENCY	Sonar operating frequency in Hz. From record 7000	U	4
SAMPLE_RATE	Sonar system sampling rate in Hz. From record 7000	U	4
RECEIVER_BANDWIDTH	Sonar system signal bandwidth in Hz. From record 7000	U	4
TX_PULSE_WIDTH	Transmit pulse length in seconds. From record 7000	U	4

Field Name	*Description*	*Field Type*	*Count*
TX_PULSE_TYPE_ID	0=CW, 1=Linear chirp, from record 7000	U	4
TX_PULSE_ENVLP_ID	0=Tapered rectangular, 1=Tukey, 2=Hamming, 3=Han, 4=Rectangular, from record 7000	U	4
TX_PULSE_ENVLP_PARAM	four byte field containing envelope parameter, no definition or units available, from record 7000	U	4
TX_PULSE_MODE	1 – Single ping, 2= Multi-ping 2, 3=Multi-ping 3, 4=Multi-ping 4	U	2
TX_PULSE_RESERVED	Two byte field, reserved space, from record 7000	U	2
MAX_PING_RATE	Maximum ping rate in pings per second, from record 7000	U	4
PING_PERIOD	seconds since last ping, from record 7000	U	4
RANGE	Sonar range selection in meters, from record 7000	U	4
POWER	Power selection in dB re 1 microPa, from record 7000	U	4
GAIN	Gain selection in dB, from record 7000	U	4

Field Name	*Description*	*Field Type*	*Count*
CONTROL_FLAGS	0-3: Auto range method 4-7: Auto bottom detect filter method 8: Bottom detect range filter 9: Bottom detect depth filter 10: Receiver gain method Auto Gain 11: Receiver gain method Fixed Gain 12-14: Auto receiver gain method 15-31: Reserved	U	4
PROJECTOR_ID	Projector selection, from record 7000	U	4
PROJECTOR_STEER_ANGL_VERT	Projector beam steering angle vertical in degrees, from record 7000	U	4
PROJECTOR_STEER_ANGL_HORZ	Projector beam steering angle horizontal in degrees, from record 7000	U	4
PROJECTOR_BEAM_WDTH_VERT	Projector beam width vertical in degrees, from record 7000	U	2
PROJECTOR_BEAM_WDTH_HORZ	Projector beam width horizontal in degrees, from record 7000	U	2
PROJECTOR_BEAM_FOCAL_PT	Projector beam focal point in meters, from record 7000	U	4
PROJECTOR_BEAM_WEIGHTING_WINDOW_TYPE	0-Rectangular, 1-Chebychhev, 2-Gauss from record 7000	U	4
PROJECTOR_BEAM_WEIGHTING_WINDOW_PARAM	four byte projector weighting parameter, no definition or units available, from record 7000	U	4

Field Name	***Description***	***Field Type***	***Count***
TRANSMIT_FLAGS	0-3: Pitch stabilization method 4-7: Yaw stabilization method 8-31: Reserved	U	4
HYDROPHONE_ID	hydrophone selection, from record 7000	U	4
RECEIVING_BEAM_WEIGHTING_WINDOW_TYPE	0-Chebychev, 1-Kaiser, from record 7000	U	4
RECEIVING_BEAM_WEIGHTING_WINDOW_PARAM	four byte receiver weighting parameter, no definition or units available, from record 7000	U	4
RECEIVE_FLAGS	0: Roll compensation indicator 1: Reserved 2: Heave compensation indicator 3: Reserved 4-7: Dynamic focusing method 8-11: Doppler compensation method 12-15: Match filtering method 16-19: TVG method 20-23: Multi-Ping Mode 24-31: Reserved	U	4
RECEIVE_BEAM_WIDTH	angle in degrees, from record 7000	U	2
RANGE_FILT_MIN	range filter, minimum value, meters, from record 7000	I	2
RANGE_FILT_MAX	range filter, maximum value, meters, from record 7000	I	2
DEPTH_FILT_MIN	depth filter, minimum value, meters, from record 7000	I	2

Field Name	***Description***	***Field Type***	***Count***
DEPTH_FILT_MAX	depth filter, maximum value, meters, from record 7000	I	2
ABSORPTION	absorption in dB/km, from record 7000	U	4
SOUND_VELOCITY	sound speed in m/s at transducer, from record 7000 (0.1 m/s precision)	U	2
SV_SOURCE	0: Measured, 1: Manual, from record 7504	U	1
SPREADING	spreading loss in dB from record 7000	U	4
BEAM_SPACING_MODE	1-Equiangle, 2-Equidistant, 3-Flex, 4-Intermediate, from record 7503	U	2
SONAR_SOURCE_MODE	0-Normal, 1-Autopilot, 2-Calibration, 3+Reserved, from record 7503	U	2
COVERAGE_MODE	0-Reduce Spacing, 1-Reduce Beams, from record 7503	U	1
COVERANGE_ANGLE	coverage angle in degrees, from record 7503	U	4
HORIZONTAL_RECEIVER_STEERING_ANGLE	Horizontal receiver beam steering angle in degrees, from record 7503	I	4
RESERVED	Spare space for future use	U	3
UNCERTAINTY_TYPE		U	4
TRANSMITTER_STEERING_ANGLE	Transmitter steering angle in degrees, from record 7027	I	4

Field Name	***Description***	***Field Type***	***Count***
APPLIED_ROLL	Roll value applied to gates, zero if roll stabilization is ON	I	4
DETECTION_ALGORITHM	0-G1_Simple, 1-G1_BlendFilt, 2-G2, 3-G3, 4-IF1, 5-PS1, 6-HS1, 7-HS2 from record 7027	U	2
DETECTION_FLAGS	0-3: Uncertainty Method 4: Multidetect Enabled 5: Has snippets detection point flag	U	4
MODULE_DESCRIPTION	Device description, from record 7001	U	60
SOUND VELOCITY	Higher precision sound velocity, Replaces the value in the ResonTSeriesSensorSpecific structure if non-zero when decoded.	U	4
RESERVED	Spare space for future use	U	416
RESERVED	Spare space for future use	U	32
RESON 8100 ***Subrecord containing fields peculiar to RESON SeaBat 8100 Series sonars. This format may contain data from an 8101, 8111, 8124, 8125, 8150 or 8160 sonar.***			*52*
LATENCY	Time from ping to output (milliseconds).	I	2
PING_NUMBER	Number assigned to ping by sonar.	I	4
SONAR_ID	Least significant 4 bytes of Ethernet address.	I	4
SONAR_MODEL	Model number of sonar (8101, 8125, etc.).	I	2

Field Name	***Description***	***Field Type***	***Count***
FREQUENCY	Sonar frequency in KHz.	I	2
SURFACE_SOUND_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
SAMPLE_RATE	A/D samples per second.	I	2
PING_RATE	Pings per second.	I	2
MODE	Description of sonar mode setting.	I	2
RANGE	Description of sonar range setting.	I	2
TRANSMIT_POWER	Description of transmitter's power level.	I	2
RECEIVE_GAIN	Description of receiver's gain setting.	I	2
PULSE_WIDTH	Transmit pulse width	I	2
TVG_SPREADING	TVG spreading coefficient	I	1
TVG_ABSORPTION	TVG absorption coefficient	I	1
TRANSMIT_BEAMWIDTH	Transmit beamwidth, in tenths of degrees.	I	1
RECEIVE_BEAMWIDTH	Receive array beamwidth, in tenths of degrees.	I	1
PROJECTOR_TYPE	Description of sonar projector type.	I	1
PROJECTOR_ANGLE	Projector pitch steering angle.	I	2
RANGE_FILTER_MINIMUM	Range filter minimum value in meters.	I	2

Field Name	***Description***	***Field Type***	***Count***
RANGE_FILTER_MAXIMUM	Range filter maximum value in meters.	I	2
DEPTH_FILTER_MINIMUM	Depth filter minimum value in meters.	I	2
DEPTH_FILTER_MAXIMUM	Depth filter maximum value in meters.	I	2
FILTERS_ACTIVE	Describes if range filter and/or depth filters are active.	I	1
TEMPERATURE	Temperature at sonar head.	I	2
BEAM_SPACING	Across-track angular beam spacing in degrees.	I	2
RESERVED	Reserved for future use	I	2
KONGSBERG EM710, EM302, EM122, EM2040 ***Subrecord containing fields peculiar to Kongsberg EM710, EM302, EM122, and EM2040 series sonars.***			*48 +40*L + 102*
MODEL_NUMBER	Model number of Kongsberg sensor acquiring ping data.	I	2
PING_COUNTER	Number assigned to ping by sonar.	I	2
SERIAL_NUMBER	Serial number of multibeam sonar.	I	2
SURFACE_VELOCITY	Surface sound velocity used to calculate beam angle in tenths of meters/seconds.	I	2
TRANSDUCER_DEPTH	Depth of transducer (transmit depth) in 0.00005 meters.	I	4
VALID_DETECTIONS	Number of beams with a valid detection for this ping.	I	2

Field Name	***Description***	***Field Type***	***Count***
SAMPLING_FREQUENCY	Sampling rate (f) in 4.0e-9 Hz.	I	8
DOPPLER_CORRECTION_SCALE	Scale factor value to be applied to Doppler correction field prior to applying correction	I	4
VECHICLE_DEPTH	From 0x66 datagram, non-zero when sonar head is mounted on a sub-sea platform in 0.001 meters.	I	4
SPARE_1		I	16
TRANSMIT_SECTORS (Number Sectors)	The number of transmit sectors for this ping (*L*)	I	2
Number Sector entries of:	Array of structures with transmit sector information, cycle repeats for each sector.		
Tilt Angle	The transmitter title angle in degrees.	I	2
Focus Range	The focusing range in meters. 0.0 for no focusing.	I	2
Signal Length	The transmit signal duration in seconds.	I	4
Transmit Delay	The sector transmit delay from the first transmission in seconds.	I	4
Center Frequency	The center frequency in Hz.	I	4
Mean Absorption	The mean absorption coefficient in 0.01 dB/kilometer	I	2
Waveform ID	The signal waveform ID (0=CW, 1=FM upsweep, 2=FM downsweep)	I	1
Sector Number	The transmit sector number	I	1

Field Name	***Description***	***Field Type***	***Count***
Signal Bandwidth	The signal Bandwidth in Hz.	I	4
Spare	Spare space reserved for future use.	I	16
SPARE_2	Spare space reserved for future use.	I	16
RUN_TIME_MODEL_NUMBER	Model number for sonar head	I	2
RUN_TIME_SECONDS	Time at start of data record, in whole seconds since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_NANOSECONDS	Time at start of data record, an additional fractional portion of whole seconds expressed in nanoseconds, since 00:00:00 Coordinated Universal Time, January 1, 1970.	I	4
RUN_TIME_PING_COUNTER	Number assigned to ping by sonar	I	2
RUN_TIME_SERIAL_NUMBER	Serial number assigned to sonar head	I	2
RUN_TIME_OPERATOR_STATION_STATUS	Bit mask of status information for operator station.	I	1
RUN_TIME_PROCESSING_UNIT_STATUS	Bit mask of status information for processing unit.	I	1
RUN_TIME_BSP_STATUS	Bit mask of status for BSP.	I	1
RUN_TIME_HEAD_TRANSCEIVER_STATUS	Bit mask of status for sonar transceiver.	I	1
RUN_TIME_MODE	Identifier describing sonar mode	I	1

Field Name	***Description***	***Field Type***	***Count***
RUN_TIME_FILTER_ID	Identifier describing sonar filter	I	1
RUN_TIME_MIN_DEPTH	Minimum depth setting in meters	I	2
RUN_TIME_MAX_DEPTH	Maximum depth setting in meters	I	2
RUN_TIME_ABSORPTION	Absorption coefficient in hundredths of dB/km	I	2
RUN_TIME_PULSE_LENGTH	Transmit pulse length in microseconds	I	2
RUN_TIME_TRANSMIT_BEAM_WIDTH	Transmit beam width in tenths of degrees	I	2
RUN_TIME_POWER_REDUCTION	Transmit power reduction in dB	I	1
RUN_TIME_RECEIVE_BEAM_WIDTH	Receive beamwidth in tenths of degrees	I	1
RUN_TIME_RECEIVE_BANDWIDTH	Receive bandwidth in fifty Hz resolution	I	1
RUN_TIME_RECEIVE_GAIN	Receiver fixed gain setting in dB	I	1
RUN_TIME_CROSS_OVER_ANGLE	TVG law crossover angle in degrees	I	1
RUN_TIME_SSV_SOURCE	Source of sound speed at transducer	I	1
RUN_TIME_PORT_SWATH_WIDTH	Maximum port swath width in meters	I	2
RUN_TIME_BEAM_SPACING	Beam Spacing	I	1
RUN_TIME_PORT_COVERAGE_SECTOR	Port coverage sector in degrees	I	1
RUN_TIME_STABILIZATION	Yaw and pitch stabilization mode	I	1

Field Name	***Description***	***Field Type***	***Count***
RUN_TIME_STBD_COVERAGE_SECTOR	Starboard coverage sector in degrees	I	1
RUN_TIME_STBD_SWATH_WIDTH	Maximum starboard swath width in meters	I	2
TX_ALONG_TILT	Fixed along ship tilt of sonar transmission. This is an operator entered setting.	I	2
FILTER_ID_2	Penetration filter setting xxxx xx00 off xxxx xx01 weak xxxx xx10 medium xxxx xx11 strong	I	1
RUN_TIME_SPARE	Reserved for future use.	I	16
PU_CPU_LOAD	Percent CPU load in the processor unit	I	1
SENSOR_STATUS	Bit mask containing status of sensor inputs	U	2
ACHIVED_PORT_COVERAGE	Achieved coverage to port in degrees	I	1
ACHIEVED_STDB_COVERAGE	Achieved coverage to starboard in degrees	I	1
YAW_STABILIZATION	Yaw stabilization in degress	I	2
SPARE			16
Klein 5410 Bathymetric Sidescan			*86*

Field Name	***Description***	***Field Type***	***Count***
Subrecord containing fields peculiar to Klein 5410 sidescan/bathymetry sonar systems.			
DATA_SOURCE	Descriptor for source data format: 0 indicates SDF.	U	2
SIDE	Descriptor for port/starboard side: 0 indicates port; 1 indicates starboard.	U	2
MODEL_NUMBER	Descriptor to indicate the specific Klein model number.	U	2
ACOUSTIC_FREQUENCY	The system frequency in Hz.	U	4
SAMPLING_FREQUENCY	The sampling frequency in Hz.	U	4
PING_NUMBER	Four byte ping counter.	U	4
NUM_SAMPLES	Total number of samples for this ping.	U	4
NUM_RAA_SAMPLES	The number of valid range, angle, amplitude triplets for this ping.	U	4
ERROR_FLAGS	The error flags for this ping.	U	4
RANGE	The sonar range setting.	U	4
FISH_DEPTH	Reading from towfish pressure sensor in Volts.	U	4
FISH_ALTITUDE	Towfish altitude in m.	U	4
SOUND_SPEED	Speed of sound at the transducer face in m/s.	U	4
TX_WAVEFORM	Descriptor for transmit pulse: 0 = 132 microseconds CW; 1 = 132 microseconds FM;	U	2

Field Name	Description	Field Type	Count
	2 = 176 microseconds CW; 3= 176 microseconds FM.		
ALTIMETER	Altimeter status: 0 = passive, 1 = active.	U	2
RAW_DATA_CONFIG	Raw data configuration.	U	4
SPARE[32]	Spare space reserved for potential use in the future.	I	32
GeoAcoustics Ltd GeoSwath Plus ***Subrecord containing fields peculiar to Geoacoustics GS+ interferrometric side-scan/bathymetry sonar systems. This format may contain data from an GS+ sonar.***			*82*
DATA_SOURCE	Descriptor for source data format. 0 indicates CBF, 1 indicates RDF	I	2
SIDE	Descriptor for port/starboard side. 0 indicates port, 1 indicates starboard.	I	2
MODEL_NUMBER	Descriptor to indicate the specific GS+ model number (100, 250, 500, …)	I	2
FREQUENCY	The system frequency in Hz.	I	2
ECHOSOUNDER_TYPE	Originates from RDF format.	I	2
PING_NUMBER	Four byte ping counter	I	4
NUM_NAV_SAMPLES	The number of navigation samples included for this ping.	I	2
NUM_ATTITUDE_SAMPLES	The number of attitude samples included for this ping.	I	2

Field Name	*Description*	*Field Type*	*Count*
NUM_HEADING_SAMPLES	The number of heading samples included for this ping.	I	2
NUM_MINISVS_SAMPLES	The number of surface sound speed measurements for this ping.	I	2
NUM_ECHOSOUNDER_SAMPLES	The number of vertical beam echo sounder samples for this ping.	I	2
NUM_RAA_SAMPLES	The number of range, angle, amplitude triplets for this ping.	I	2
MEAN_SV	The mean sound speed in m/s	I	2
SURFACE_VELOCITY	The sound speed at the transducer	I	2
VALID_BEAMS	The number of valid measurements for this ping	I	2
SAMPLE_RATE	The sonar system sample rate in Hz.	I	2
PULSE_LENGTH	The acoustic pulse length in microseconds	I	2
PING_LENGTH	The ping length in meters	I	2
TRANSMIT_POWER	The sonar system transmit power	I	2
SIDESCAN_GAIN_CHANNEL	The sonar system gain	I	2
STABILIZATION	0 indicates no stabilization, 1 indicates pitch stabilized	I	2
GPS_QUALITY	GPS quality indicator from RDF	I	2
RANGE_UNCERTAINTY	The range measurement uncertainty in meters	I	2

Field Name	Description	Field Type	Count
ANGLE_UNCERTAINTY	The angle measurement uncertainty in degrees	I	2
SPARE[32]	Spare space reserved for potential us in the future.	I	32
Imagenex Delta T ***Subrecord containing fields peculiar to the Imagenex Delta T multibeam sonar***			*93*
FILE EXTENSION	Source data file extension	C	4
VERSION NUMBER	Imagenex minor version number	C	1
PING BYTE SIZE	Size in bytes for this ping	I	2
INTERROGATION TIME	The sonar interrogation time.	I	8
SAMPLES PER BEAM	The number of samples for this beam	U	2
SECTOR SIZE	Size of the swath sector in degrees	U	2
START ANGLE	Angle in degrees for beam index 0	I	2
ANGLE INCREMENT	Spacing between beams in degrees	U	2
ACOUSTIC RANGE	The maximum slant range in meters.	U	2
ACOUSTIC FREQUENCY	The frequency for this system in kHz.	U	2
SOUND SPEED	Ambient sound speed at transducer in meters/second.	U	2
RANGE RESOLUTION	Range resolution in meters	U	2
PROFILE TILT	The mounting offset in degrees	I	2
REPETITION RATE	The interval ping pings in seconds.	U	2

Field Name	*Description*	*Field Type*	*Count*
PING NUMBER	The sonar assigned ping sequence number	U	4
INTENSITY FLAG	=1 if per receive beam amplitude is available, otherwise =0	C	1
PING LATENCY	Time difference from interrogation to actual ping in seconds.	U	2
DATA LATENCY	Time difference from ping to data output in seconds.	U	2
SAMPLE RATE FLAG	0 = 1/500, 1 = 1/5000	U	1
OPTION FLAGS	As set by the sonar system. Bit 0 is set if data is corrected for roll. Bit 1 is set is data is corrected fro ray bending.	C	1
NUMBER PINGS AVERAGED	The number of pings averaged. This value ranges from 0 – 25.	C	1
CENTER_PING_TIME_OFFSET	The time difference in seconds between the center ping interrogation and the current ping interrogation.	I	2
USER DEFINED BYTE	Contains a user defined single byte value.	C	1
ALTITUDE	the height of the platform above the ocean floor in meters.		4
EXTERNAL SENSOR FLAGS	This flag is a bit mask where (1 =external heading, 2 = external roll, 4 = external pitch, 8 = external heave)	C	1
PULSE LENGTH	Acoustic pulse length in seconds	I	4

Field Name	***Description***	***Field Type***	***Count***
FORE AFT BEAM WIDTH	Effective f/a beam width in degrees	I	1
ATHWARTSHIPS BEAM WIDTH	Effective athwart ships beam width in degrees.	I	1
SPARE[32]	Spare space reserved for potential us in the future.	I	32
R2Sonic ***Subrecord containing fields particular to R2Sonic models 2020, 2022 and 2024***			*204*
MODEL_NUMBER	Model number, e.g., 2020, 2022 or 2024	T	12
SERIAL_NUMBER	Serial number	T	12
TIME	Time of the ping	I	8
PING_NUMBER	Number assigned to the ping by the sonar	I	4
PING_PERIOD	Time between two most recent pings (seconds)	I	4
SOUND_SPEED	Speed of sound at the transducer (meters/second)	I	4
FREQUENCY	Sonar center frequency (Hz)	I	4
TX_POWER	Description of transmitter's power level	I	4
TX_PULSE_WIDTH	Transmit pulse length (seconds)	I	4
BEAMWIDTH_VERT	Beamwidth in the vertical direction (radians)	I	4

Field Name	***Description***	***Field Type***	***Count***
BEAMWIDTH_HORIZ	Beamwidth in the horizontal direction (radians)	I	4
TX_STEERING_VERT	Transmit steering angle in the vertical direction (radians)	I	4
TX_STEERING_HORIZ	Transmit steering angle in the horizontal direction (radians)	I	4
TX_MISC_INFO	Miscellaneous information; to be determined	I	4
RX_BANDWIDTH	Receiver bandwidth (Hz)	I	4
RX_SAMPLE_RATE	Sample rate of data acquisition and signal processing (Hz)	I	4
RX_RANGE	Two-way time (seconds)	I	4
RX_GAIN	Receiver gain	I	4
RX_SPREADING	Receiver spreading (dB)	I	4
RX_ABSORPTION	Receiver absorption (dB/km)	I	4
RX_MOUNT_TILT	Receiver mount tilt angle (radians)	I	4
RX_MISC_INFO	Reserved for future use; to be determined	I	4
RESERVED	Reserved for future use	I	2
NUM_BEAMS	Number of beams in this ping	I	2
A0_MORE_INFO	Additional fields associated with equi-angular mode; first element of array is roll	I	6*4

Field Name	Description	Field Type	Count
A2_MORE_INFO	Additional fields associated with equi-distant mode; first elements of array is roll	I	6*4
G0_DEPTH_GATE_MIN	Global minimum gate (seconds)	I	4
G0_DEPTH_GATE_MAX	Global maximum gate (seconds)	I	4
G0_DEPTH_GATE_SLOPE	Slope of depth gate (radians)	I	4
SPARE	Reserved for future use	I	32
SB_ECHOTRAC ***Subrecord containing fields peculiar to ODOM Echotrac and PDD single-beam sonars, as well as ODEC Bathy 2000 single-beam sonars.***			*10*
NAV_ERROR	Navigation error.	I	2
MPP_SOURCE	Flag to determine source of navigation.	I	1
TIDE_SOURCE	Source of tide correctors, this information should also be stored in the ping flags.	I	1
DYNAMIC_DRAFT	Speed induced draft in meters	I	2
SPARE	Reserved for future use.	I	4
SB_MGD77 ***Subrecord containing fields peculiar to MGD77 single-beam archival data.***			*18*
TIME_ZONE_CORR	Time zone corrector	I	2
POSITION_TYPE_CODE	Position type code.	I	2
CORRECTION_CODE	Manner in which sound velocity correction was made.	I	2

Field Name	***Description***	***Field Type***	***Count***
BATHY_TYPE_CODE	Manner in which bathymetry was obtained	I	2
QUALITY_CODE	Navigation quality code.	I	2
TRAVEL_TIME	Two way travel time in 0.0001 seconds	I	4
SPARE	Reserved for future use.	I	4
SB_BDB ***Subrecord containing fields peculiar to BDB single-beam archival data..***			*14*
DOC_NO	Doc. No.	I	4
EVAL	Evaluation flag.	I	1
CLASSIFICATION	Classification flag.	I	1
TRACK_ADJ_FLAG	Track adjustment flag.	I	1
SOURCE_FLAG	Source flag.	I	1
PT_OR_TRACK_LN	Discrete point of track line flag.	I	1
DATUM_FLAG	Datum flag	I	1
SPARE	Reserved for future use.	I	4
SB_NOSHDB ***Subrecord containing fields peculiar to NOS HDB single-beam archival data..***			*8*
TYPE_CODE	Depth type code	I	2
CARTO_CODE	Cartographic code	I	2
SPARE	Reserved for future use.	I	4

Field Name	***Description***	***Field Type***	***Count***
SB_NAVISOUND ***Subrecord containing fields peculiar to Navisound single-beam data.***			*10*
PULSE_LENGTH	Pulse length in meters.	I	2
SPARE	Reserved for future use.	I	8

Appendix B.2 Single-beam Sounding Sensor-specific Subrecord Definitions

The sensor-specific subrecords are defined for use within Single-beam Sounding Ping Records. Subrecord identifiers for each subrecord are defined in Appendix A.3. This specification does not provide detailed information about the data items within these subrecords. Usage of these data requires a detailed knowledge of the sensor being used.

Table B-2 Single-beam Sounding Sensor-specific Subrecord Definitions

Field Name	***Description***	***Field Type***	***Count***
ECHOTRAC ***Subrecord containing fields peculiar to ODOM Echotrac sonar.***			*4*
NAV_ERROR	Navigation error	I	2
NAV_SOURCE	Source of navigation	I	1
TIDE_SOURCE	Source of tide correctors.	I	1
BATHY2000 ***Subrecord containing fields peculiar to ODEC Bathy 2000 sonar.***			*4*
NAV_ERROR	Navigation error	I	2
NAV_SOURCE	Source of navigation	I	1
TIDE_SOURCE	Source of tide correctors.	I	1
MGD77 ***Subrecord containing fields peculiar to MGD77 archival data.***			*14*
TIME_ZONE_CORR	Time zone corrector	I	2
POSITION_TYPE_CODE	Position type code.	I	2
CORRECTION_CODE	Manner in which sound velocity correction was made.	I	2

Field Name	***Description***	***Field Type***	***Count***
BATHY_TYPE_CODE	Manner in which bathymetry was obtained	I	2
QUALITY_CODE	Navigation quality code.	I	2
TRAVEL_TIME	Two way travel time in 0.0001 seconds	I	4
BDB ***Subrecord containing fields peculiar to BDB archival data..***			*10*
DOC_NO	Doc. No.	I	4
EVAL	Evaluation flag.	I	1
CLASS	Classification flag.	I	1
TRACK_ADJ_FLAG	Track adjustment flag.	I	1
SOURCE_FLAG	Source flag.	I	1
PT_OR_TRACK_LN	Discrete point of track line flag.	I	1
DATUM_FLAG	Datum flag	I	1
NOSHDB ***Subrecord containing fields peculiar to NOS HDB archival data..***			*4*
TYPE_CODE	Depth type code	I	2
CARTO_CODE	Cartographic code	I	2

Appendix B.3 Bathymetric Receive Beam Imagery Sensor-specific Subrecord Definitions

The sensor-specific subrecords are defined for use within Bathymetric Receive Beam Intensity Ping subecords, and Wide Receive Beam Intensity subrecords. This specification does not provide detailed information about the data items within these subrecords. Usage of these data requires a detailed knowledge of the sensor being used.

Table B-3 Imagery Sensor-specific Subrecord Definitions

Field Name	*Description*	*Field Type*	*Count*
KONGSBERG EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS ***Subrecord containing fields specific to Kongsberg EM120, EM300, EM1002, EM2000, EM3000, EM3002, and EM121A_SIS series sonars.***			*18*
RANGE_NORM	Range to normal incidence used to correct sample amplitudes (in samples)	I	2
START_TVG_RAMP	Start range sample of TVG ramp if not enough dynamic range (0 else)	I	2
STOP_TVG_RAMP	Stop range sample of TVG ramp if not enough dynamic range (0 else)	I	2
BSN	Normal incidence BS in dB	I	1
BSO	Oblique BS in dB	I	1
MEAN_ABSORPTION	Mean absorption coefficient in dB/km, resolution of 0.01 dB/km.	I	2
Offset	The DC offset used to scale imagery sample received from the sonar to range of positive values for storage in GSF.	I	2
Scale	The multiplier used to scale the values received from the sonar to range of positive values for storage in GSF.	I	2
SPARE	For future use.	I	4
RESON 7100 ***Subrecord containing fields peculiar to RESON SeaBat 7100 Series sonars. This format may contain data from a 7125 sonar.***			*66*
SIZE	The size of the imagery specific record	U	2

Field Name	***Description***	***Field Type***	***Count***
SPARE	For future use	U	64
RESON T Series ***Subrecord containing fields peculiar to RESON SeaBat T Series sonars. This format may contain data from a T-20 or T-50 sonar.***			*66*
SIZE	The size of the imagery specific record	U	2
SPARE	For future use	U	64
RESON 8100 ***Subrecord containing fields peculiar to RESON SeaBat 8100 Series sonars. This format may contain data from an 8101, 8111, 8125, 8150 or 8160 sonar.***			*8*
SPARE	For future use.	I	8
KONGSBERG EM122, EM302, EM710, EM2040 ***Subrecord containing fields peculiar to Kongsberg EM122, EM302, EM710, and EM2040 series sonars.***			*50*
SAMPLING_FREQUENCY	The sonar system digitizing rate in 4e-9 Hz.	I	8
MEAN_ABSORPTION	The mean absorption coefficient in dB/kilometer.	I	2
TX_PULSE_LENGTH	The transmit pulse length in microseconds	I	2
RANGE_NORM	The range to normal incidence (in samples) used to correct sample amplitudes.	U	2
START_TVG_RAMP	The start range (in samples) of TVG ramp if not enough dynamic range, 0 means not used.	U	2

Field Name	*Description*	*Field Type*	*Count*
STOP_TVG_RAMP	The stop range (in samples) of TVG ramp if not enough dynamic range, 0 means not used.	U	2
BSN	The normal incidence BS in dB.	I	2
BSO	The oblique incidence in BS in dB.	I	2
TX_BEAM_WIDTH	The transmit beam width in 0.1 degrees.	I	2
TVG_CROSS_OVER	The TVG law crossover angle in 0.1 degrees.	I	2
Offset	The DC offset used to scale imagery sample received from the sonar to range of positive values for storage in GSF.	I	2
Scale	The multiplier used to scale the values received from the sonar to range of positive values for storage in GSF.	I	2
SPARE		I	20
KONGSBERG KMALL SYSTEMS ***Subrecord containing fields peculiar to Kongsberg KMALL sonars***			
SPARE		I	64
Klein 5410 Bathymetric Sidescan ***Subrecord containing fields peculiar to Klein 5410 sidescan/bathymetry sonar systems.***			*18*
RES_MODE	Descriptor for resolution mode: 0 = normal; 1 = high.	U	2
TVG_PAGE	TVG page number.	U	2

Field Name	Description	Field Type	Count
BEAM_ID[5]	An array of identifiers for five sidescan beam magnitude time series, starting with beam id 1 as the forward-most.	U	2*5
SPARE	For future use.	I	4
R2Sonic Imagery ***Subrecord containing fields particular to R2Sonic Models 2020, 2022 and 2024***			*168*
MODEL_NUMBER	Model number; e.g., 2020, 2022 or 2024	T	12
SERIAL_NUMBER	Serial number	T	12
TIME	Time of the ping	I	8
PING_NUMBER	Number assigned to the ping by the sonar	I	4
PING_PERIOD	Time between two most recent pings (seconds)	I	4
SOUND_SPEED	Speed of sound at the transducer (meters/second)	I	4
FREQUENCY	Sonar center frequency (Hz)	I	4
TX_POWER	Description of transmitter's power level	I	4
TX_PULSE_WIDTH	Transmit pulse length (seconds)	I	4
TX_BEAMWIDTH_VERT	Beam width in the vertical direction (radians)	I	4
TX_BEAMWIDTH_HORIZ	Beam width in the horizontal direction (radians)	I	4
TX_STEERING_VERT	Transmit steering angle in the vertical direction (radians)	I	4

Field Name	***Description***	***Field Type***	***Count***
TX_STEERING_HORIZ	Transmit steering angle in the horizontal direction (radians)	I	4
TX_MISC_INFO	Miscellaneous information; to be determined	I	4
RX_BANDWIDTH	Receiver bandwidth (Hz)	I	4
RX_SAMPLE_RATE	Sample rate of data acquisition and signal processing (Hz)	I	4
RX_RANGE	Two-way time (seconds)	I	4
RX_GAIN	Receiver gain	I	4
RX_SPREADING	Receiver spreading (dB)	I	4
RX_ABSORPTION	Receiver absorption (dB/km)	I	4
RX_MOUNT_TILT	Receiver mount tilt angle (radians)	I	4
RX_MISC_INFO	Reserved for future use; to be determined	I	4
RESERVED	Reserved for future use	I	2
NUM_BEAMS	Number of beams in this ping	I	2
MORE_INFO	Reserved for future use	I	6*4
SPARE	Reserved for future use	I	32

Appendix C.1 Standard Ping Flag Definitions

The ping flags are used to indicate if a ping is valid and to offer information about how the original ping may have been altered. These alterations occur if delayed heave, vertical control or tides have been applied to the data. The ping flag is a 16 bit value; each bit translates to a particular code. The combination of the 16 bits gives us information about the ping. Bits 0 through 11 indicate if the ping should be ignored. Bits 12 through 15 are informational bits that describe corrections that may have been applied to the ping.

The following definitions represent commonly used definitions for the GSF ping bit flags. If GSF_IGNORE_PING is set and nothing else is set then the whole ping had no bottom detections made, otherwise bits 1 through 11 specify the reason(s) why the ping was flagged.

IGNORE_PING	GSF_IGNORE_PING
OFF_LINE_PING	GSF_PING_USER_FLAG_01
BAD_TIME	GSF_PING_USER_FLAG_02
BAD_POSITION	GSF_PING_USER_FLAG_03
BAD_HEADING	GSF_PING_USER_FLAG_04
BAD_ROLL	GSF_PING_USER_FLAG_05
BAD_PITCH	GSF_PING_USER_FLAG_06
BAD_HEAVE	GSF_PING_USER_FLAG_07
BAD_DEPTH_CORRECTOR	GSF_PING_USER_FLAG_08
BAD_TIDE_CORRECTOR	GSF_PING_USER_FLAG_09
BAD_SVP	GSF_PING_USER_FLAG_10
NO_POSITION	GSF_PING_USER_FLAG_11

The bit GSF_PING_USER_FLAG_12 is used to indicate that a delayed heave correction has been applied.

DELAYED_HEAVE_APPLIED	GSF_PING_USER_FLAG_12

The GSF_PING_USER_FLAG_13 bit is used to indicate that vertical control has been established by GPS. When GSF_PING_USER_FLAG_13 is set, the value of the gps_tide_corrector field has been added to the depths. When GSF_PING_USER_FLAG_13 is cleared, any non-zero value for the tide_corrector_field has been added to the depths.

GPS_BASED_VERTICAL_CONTROL GSF_PING_USER_FLAG_13

The bits GSF_PING_USER_FLAG_14 and GSF_PING_USER_FLAG_15 are used to describe the source of the tide correctors applied to a ping, as described in Table C-1.

Table C-1 Ping Flag Tide Source Descriptions

Source of tide corrector.	***Bit 15***	***Bit 14***
Unknown	0	0
Predicted	0	1
Observed, preliminary	1	0
Observed, verified	1	1

An example of ping flags is shown in Table C-2. In this example, bits 14 and 15 are set. This indicates that observerd, verified tides have been applied to this ping. If only bit 14 were set, it would mean that predicted tides have been applied. If only bit 15 were set, it would mean that observed, preliminary tides have been applied.

TABLE C-2. EXAMPLE PING FLAG, OBSERVED, VERIFIED TIDES APPLIED

Bit Number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Another example of ping flags is shown in Table C-3. In this example, bit 12 has been set, indicating that delayed heave has been applied.

TABLE C-3. EXAMPLE PING FLAG, DELAYED HEAVE APPLIED

Bit Number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

The first bit, bit 0, is defined as the "Ignore Ping" bit. If this first bit is 0, the ping is considered valid. If the ping is invalid, bit 0 is 1 and bits 1 through 11 are used to provide information about why the ping is invalid. Table C-4 shows an example of an invalid ping. In this case, the ping is invalid because it has a bad position. If a ping is flagged as invalid in the first bit, but bits 1 through 11 are all 0, then the ping did not get bottom detection.

TABLE C-4. EXAMPLE PING FLAG, PING IS INVALID BECAUSE OF BAD POSITION

Bit Number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1

Appendix C.2 Standard Beam Flag Definitions

Each beam within a ping has an 8 bit beam flag that provides information about the beam. The lower order two bits of the eight bit beam flag value are used to categorize the flag as either informational, a beam to ignore, or a selected beam. When the first two bits designate that a beam is flagged as ignore, the remaining bits specify the reason the beam is to be ignored. When the first two bits designate that a beam is selected, the remaining six bits specify the reason why the beam is selected. The only informational bit defined is that a beam exceeds "class 1" criteria.

<u>Category 00 (INFORMATIONAL)</u>

xxx1xx00 => This beam exceeds class 1 criteria.

<u>Category 01 (IGNORE)</u>

00000001 => This beam is to be ignored, no detection was made by the sonar.

xxxxx101 => This beam is to be ignored, it has been manually edited.

xxxx1x01 => This beam is to be ignored, it has been filter edited.

xx1xxx01 => This beam is to be ignored, since it exceeds "class 2" criteria.

x1xxxx01 => This beam is to be ignored, since it exceeds the maximum footprint.

1xxxxx01 => This beam is to be ignored, since it exceeds the uncertainty criteria.

<u>Category 10 (SELECTED)</u>

00000010 => Selected sounding, no reason specified.

xxxxx110 => Selected sounding, it is a least depth.

xxxx1x10 => Selected sounding, it is a maximum depth.

xx1xxx10 => Selected sounding, it is as a feature [1]

x1xxxx10 => Selected sounding, spare.

1xxxxx10 => Selected sounding, it is a designated sounding [2]

[1] A feature is an identified least depth associated with an object on the seafloor that is of charting significance. All features result in an override of the final bathymetry model.

[2] A designated sounding creates an override of the final bathymetry model, but is not of charting significance.

Bit 0 is defined as the “ignore beam” bit. If this bit is 0 the beam is considered valid and should be used for processing. If the beam is invalid, this bit will be set to 1 and the other bits will provide information as to why the beam is invalid. Table C-5 shows an example of beam flags. In this case, bits 0 and 7 are set, meaning the beam should be ignored because it exceeds the uncertainty criteria. If bit 0 is 1 and none of the other bits are set, it means that beam had no bottom detection.

TABLE C-5. BEAM FLAGGED AS 'IGNORE' BECAUSE THE UNCERTAINTY CRITERIA IS EXCEEDED

Bit Number	7	6	5	4	3	2	1	0
Value	1	0	0	0	0	0	0	1

Bit 1 is defined as the “selected sounding” bit. If this bit is set, that indicates that this beam’s depth has some special significance. The other bits in the beam flags will describe why this sounding has been selected. Table C-6 gives an example of a beam with bits 1 and 6 set, meaning the sounding has been selected as a feature.

TABLE C-6. BEAM FLAGGED AS 'SELECTED' AS A FEATURE

Bit Number	7	6	5	4	3	2	1	0
Value	0	0	1	0	0	0	1	0

If none of the bits in the beam flag are set, the beam is valid. Bits 0 and 1 should be mutually exclusive; i.e. an invalid beam should never be a selected sounding.

Appendix C.3 Flag Mapping Between GSF and HDCS

Table C-7 gives a useful mapping of HDCS flags to GSF flags. Table C-8 gives the reverse mapping of GSF flags to HDCS flags.

TABLE C-7 MAPPING OF HDCS FLAGS TO GSF FLAGS

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
OD_EXAMINED_BY_HYDROG_MASK	Indicates that the data has been examined by a hydrographer. It is not currently used by HIPS programs.	No flag to be applied to GSF file upon export from HDCS.		
OD_EXAMINED_BY_FILTER_MASK	Indicates that the data has been flagged using a depth filter. It is set by the conversion programs when converting raw data into HIPS files. This flag is not used by any other HIPS programs.	No flag to be applied to GSF file upon export from HDCS.		
OD_SVP_CORRECTED_MASK	Indicates that the observed depths file has been generated by post-processing sound velocity correction algorithm. This algorithm is part of the **hdcs** merge algorithm.	No flag to be applied to GSF file upon export from HDCS.		
OD_SINGLEBEAM_MASK	Indicates that the observed depths file contains single beam data. A single beam file may contain single or dual frequency soundings.	No flag to be applied to GSF file upon export from HDCS.		

Profiles:

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
OD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.	0001	0000 0000 0000 0001	IGNORE_PING
OD_PROFILE_REJECTED_BY_HYDROG_MASK	Indicates that the profile is rejected by the hydrographer. This flag is not currently being used.	0001	0000 0000 0000 0001	IGNORE_PING
OD_PROFILE_BAD_SVP_MASK	Indicates that the profile has been rejected as a result of SVP correction.	0401	0000 0100 0000 0001	BAD_SVP

Depths:

OD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits.	01	0000 0001	Null Invalidated - No detection was made by the sonar
OD_DEPTH_REJECTED_BY_SWATHED_MASK	Indicates that the sounding was reject by the user in the swath editor. Soundings that are rejected in this manner are not displayed in the **hdcs** subset mode.	05	0000 0101	Manually edited (i.e., MVE).
OD_DEPTH_DISABLED_BEAM_MASK	Indicates that the reason for rejection was because the beam was disabled. The VCF dictates the status (enabled or disabled) for each beam. The conversion programs read the VCF and set the status word accordingly. Soundings that have been rejected in this manner do not appear during subsequent processing.	01	0000 0001	Null Invalidated - No detection was made by the sonar

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
OD_DEPTH_REJECTED_BY_GATE_MASK	Indicates that the reason for rejection was because the beam failed the minimum and maximum depth criteria. This criteria is specified by the user in the conversion programs. Any soundings that are rejected because of this criteria do not appear during subsequent processing.	09	0000 1001	Filter edited
OD_DEPTH_QUALITY_0_MASK	Indicates that the bit 0 of the 2-bit sounding quality flag is set.	No flag to be applied to GSF file upon export from HDCS.		
OD_DEPTH_QUALITY_1_MASK	Indicates that the bit 1 of the 2-bit sounding quality flag is set.	No flag to be applied to GSF file upon export from HDCS.		
OD_DEPTH_DECIMATED_MASK	Indicates that the sounding is flagged as decimated. Word on the street is that this bit will be renamed to something else and used for different purposes. Seems like no users are decimating their datasets.	No flag to be applied to GSF file upon export from HDCS.		
OD_DEPTH_REJECTED_BY_SVP_MASK	Indicates that the sounding has been rejected as a result of SVP correction. This will happen when the SVP algorithm is unable to compute a solution for a transmitted beam.	01	0000 0001	Null Invalidated - No detection was made by the sonar
OD_DEPTH_REJECTED_BY_TOTAL_PROPAGATION_ERROR (TPE)	Indicates that the reason for rejection was because the beam failed Total Propagation Error (TPE).	81	1000 0001	This beam is to be ignored, it exceeds the IHO standards for Horizontal

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
				OR Vertical error.
OD_DEPTH_REJECTED_BY_HYDROG_MASK	Indicate that depth has been rejected manually. This is basically a mirror of the processed depths flag, where the actual functions are implemented. Again this flag's been around for a while.	05	0000 0101	Manually edited (i.e., MVE).
OD_DEPTH_REJECTED_BY_STATISTICAL_MASK	Indicate that depth has been rejected by statistical functions. This is basically a mirror of the processed depths flag, where the actual functions are implemented.	09	0000 1001	Filter edited
OD_DEPTH_DESIGNATED_MASK	This is the only sounding bit which indicates that a sounding is a "selected" sounding. A user has to manually select a sounding, and no reason for selection is stored. This is basically a mirror of the processed depths flag, where the actual functions are implemented.	02	0000 0010	Selected sounding, no reason specified
OD_DEPTH_REJECTED_BY_CUBE_MASK		09	0000 1001	Filter edited

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
OD_DEPTH_SECONDHEAD_MASK	OD_DEPTH_SECONDHEAD_MASK is a new bit that is used to indicate that a sounding in the observed depths data belong to a second transducer head. It is used so that during processing, the code is able to treat soundings differently depending on whether it is coming from transducer head #1, or #2. Some caveats: a) For backward compatibility, if this bit is NOT set, it does not automatically mean that a sounding is coming from transducer head #1. Previously, for some sonar systems, we had used one of the quality bits to differentiate dual transducer data. We have not modified those converters to use the new bit. b) Even if this bit is NOT set, the HIPS vessel file can still be used to separate dual transducer data. This is achieved by having a dual transducer swath setup, with a fixed number of beams for the first transducer head. Again, this is done for backward compatibility. c) This bit is not duplicated in the processed depths file. If it is necessary for whatever processing reasons, we read it from the observed depth file.	No flag to be applied to GSF file upon export from HDCS.		

Processed Depths File

Line:

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
PD_EXAMINED_BY_HYDROG_MASK	Indicates that the data has been examined by a hydrographer. It is set by the merging program.	No flag to be applied to GSF file upon export from HDCS.		
PD_EXAMINED_BY_FILTER_MASK	Indicates that the data has been flagged using a depth filter. It is set by the merging program.	No flag to be applied to GSF file upon export from HDCS.		
PD_REJECT_ENTIRE_LINE_MASK	Implies that the entire line has been rejected. It is not currently used.	No flag to be applied to GSF file upon export from HDCS.		
PD_CHECK_LINE_MASK	This bit is used by the CHS to indicate that the survey is a Check Line. This bit is set to be the same as the one in the Navigation file.	No flag to be applied to GSF file upon export from HDCS.		
PD_PATCH_TEST_LINE_MASK	This bit is used by the CHS to indicate that the survey is a Patch Test Line. This bit is set to be the same as the one in the Navigation file.	No flag to be applied to GSF file upon export from HDCS.		
PD_SHOAL_EXAMINATION_LINE_MASK	This bit is used by the CHS to indicate that the survey is a Shoal Examination Line. This bit is set to be the same as the one in the Navigation file.	No flag to be applied to GSF file upon export from HDCS.		
PD_TRACK_LINE_MASK	This bit is used by the CHS to indicate that the survey is a Track Line. This bit is set to be the same as the one in the Navigation file.	No flag to be applied to GSF file upon export from HDCS.		

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
PD_TIDE_APPLIED_MASK	This bit indicates that tide has been applied to the data. It is set by the merging program.	No flag to be applied to GSF file upon export from HDCS.		
PD_SVP_CORRECTED_MASK	This is a mirror of the bit in the observed depths file, where the SV correction functions are implemented. It indicates that the line has been SV corrected.	No flag to be applied to GSF file upon export from HDCS.		

Profiles:

PD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.	0001	0000 0000 0000 0001	IGNORE_PING
PD_PROFILE_REJECTED_BY_HYDROG_MASK	Indicates that the profile is rejected by the hydrographer. This flag is not currently being used.	0001	0000 0000 0000 0001	IGNORE_PING
PD_PROFILE_BAD_GYRO_MASK	Indicates that the profile is rejected because of bad gyro reading. This flag is not currently being used.	0011	0000 0000 0001 0001	BAD_HEADING
PD_PROFILE_BAD_HEAVE_MASK	Indicates that the profile is rejected because of bad heave reading. This flag is not currently being used.	0081	0000 0000 1000 0001	BAD_HEAVE
PD_PROFILE_BAD_NAVIGATION_MASK	Indicates that the profile is rejected because of bad navigation reading. This flag is not currently being used.	0009	0000 0000 0000 1001	BAD_POSITION
PD_PROFILE_BAD_PITCH_MASK	Indicates that the profile is rejected because of bad pitch reading. This flag is not currently being used.	0041	0000 0000 0100 0001	BAD_PITCH

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
PD_PROFILE_BAD_ROLL_MASK	Indicates that the profile is rejected because of bad roll reading. This flag is not currently being used.	0021	0000 0000 0010 0001	BAD_ROLL
PD_PROFILE_BAD_TIDE_MASK	Indicates that the profile is rejected because of bad tide reading. This flag is not currently being used.	0201	0000 0010 0000 0001	BAD_TIDE_CORRECTOR
PD_PROFILE_BAD_SVP_MASK	This is a mirror of the bit in the observed depths file, where the SV correction functions are implemented. It indicates that the profile is rejected because of interpolation errors during the SV correction procedure.	0401	0000 0100 0000 0001	BAD_SVP
PD_PROFILE_BAD_DRAFT_MASK	This is set by the merge function, and indicates that the profile is rejected because vessel draft cannot be interpolated.	0101	0000 0001 0000 0001	BAD_DEPTH_CORRECTOR

Depths:

PD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits. This bit is inherited from the Observed Depths file but can be changed by **hdcs**.	01	0000 0001	Null Invalidated - No detection was made by the sonar
PD_DEPTH_REJECTED_BY_HYDROG_MASK	Indicates that the reason for rejection was because of a hydrographer's action. This bit is set by **hdcs** in subset cleaning mode.	05	0000 0101	Manually edited (i.e., MVE).
PD_DEPTH_DISABLED_BEAM_MASK	Indicates that the reason for rejection was because the beam was disabled. This bit is inherited from the Observed Depths file. Soundings that	01	0000 0001	Null Invalidated - No detection

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
	have been rejected in this manner are not visible in **hdcs**.			was made by the sonar
PD_DEPTH_REJECTED_BY_GATE_MASK	Indicates that the reason for rejection was because the beam failed the minimum and maximum depth criteria. This bit is inherited from the Observed Depths file. Soundings that have been rejected in this manner are not visible in **hdcs**.	09	0000 1001	Filter edited
PD_DEPTH_REJECTED_BY_TOTAL_PROPAGATION_ERROR (TPE)	Indicates that the reason for rejection was because the beam failed Total Propagation Error (TPE).	81	1000 0001	This beam is to be ignored, it exceeds the IHO standards for Horizontal OR Vertical error.
PD_DEPTH_OUTSTANDING_MASK	This is not a rejection flag. It is set by **hdcs** subset mode, and indicates that the sounding should be examined further.	No flag to be applied to GSF file upon export from HDCS.		
PD_DEPTH_EXAMINED_MASK	This is not a rejection flag. It is set by **hdcs** subset mode, and indicates that the sounding has been verified.	No flag to be applied to GSF file upon export from HDCS.		
PD_DEPTH_REJECTED_BY_SWATHED_MASK	Indicates that the sounding has been rejected in the swath editor. Soundings which are rejected in this manner are not visible in older versions of **hdcs**, but are visible in the newer PC based software.	05	0000 0101	Manually edited (i.e., MVE).
PD_DEPTH_QUALITY_0_MASK	Indicates that the bit 0 of the 2-bit sounding quality flag is set.	No flag to be applied to GSF file		

HDCS Flags	Description	Beam Hex Code	Bitmask	Comment
		upon export from HDCS.		
PD_DEPTH_QUALITY_1_MASK	Indicates that the bit 1 of the 2-bit sounding quality flag is set.	No flag to be applied to GSF file upon export from HDCS.		
PD_DEPTH_DECIMATED_MASK	Indicates that the sounding is flagged as decimated.	No flag to be applied to GSF file upon export from HDCS.		
PD_DEPTH_REJECTED_BY_STATISTICAL_MASK	Indicate that depth has been rejected by statistical functions.	09	0000 1001	Filter edited
PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.	82	1000 0010	Selected sounding, it has been identified as a designated sounding
PD_DEPTH_REJECTED_BY_CUBE_MASK		09	0000 1001	Filter edited

TABLE C-8 MAPPING OF GSF BEAM FLAGS TO HDCS

GSF Beam Flags	Comment	CARIS Flag	Comment
0000 0010	Selected sounding, no reason specified	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.

GSF Beam Flags	Comment	CARIS Flag	Comment
0000 0110	Selected sounding, it is a least depth	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.
0000 1010	Selected sounding, it is a maximum depth	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.
0001 0000	Does NOT meet Class1 (informational flag)	No flag to be applied to HDCS files upon import from GSF.	
0001 0010	Selected sounding, average depth	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.
0010 0010	Selected sounding, it has been identified as a feature	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.
0100 0010	Spare bit Field	N/A	
0000 0001	Selected sounding, it has been identified as a designated sounding	PD_DEPTH_DESIGNATED_MASK	Indicates that the user has explicitly selected this sounding as a designated sounding.
0000 0001	Null Invalidated - No detection was made by the sonar	PD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits. This bit is inherited from the Observed Depths file but can be changed by **hdcs**.
0000 0101	Manually edited (i.e., MVE).	PD_DEPTH_REJECTED_BY_SWATHED_MASK	Indicates that the sounding has been rejected in the swath editor. Soundings which are rejected in this manner are not visible in older versions of **hdcs**, but are visible in th newer PC based software.

GSF Beam Flags	Comment	CARIS Flag	Comment
0000 1001	Filter edited	PD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits. This bit is inherited from the Observed Depths file but can be changed by **hdcs**.
0010 0001	Does NOT meet Class2	PD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits. This bit is inherited from the Observed Depths file but can be changed by **hdcs**.
0100 0001	Resolution Invalidated - Exceeds maximum footprint	PD_DEPTH_REJECTED_MASK	Indicates that the sounding has been rejected. The reason may or may not be indicated by the other bits. This bit is inherited from the Observed Depths file but can be changed by **hdcs**.
1000 0001	This beam is to be ignored; it exceeds the IHO standards for Horizontal OR Vertical error.	PD_DEPTH_REJECTED_BY_TOTAL_PROPAGATION_ERROR (TPE)	Indicates that the reason for rejection was because the beam failed Total Propagation Error (TPE).

Table C-10 Mapping of GSF ping flags to HDCS

GSF Ping Flags	Description	Proposed HDCS Mapping	Comment
0000 0000 0000 0001	IGNORE_PING	PD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.

GSF Ping Flags	Description	Proposed HDCS Mapping	Comment
0000 0000 0000 0011	OFF_LINE_PING	PD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.
0000 0000 0000 0101	BAD_TIME	PD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.
0000 0000 0000 1001	BAD_POSITION	PD_PROFILE_BAD_NAVIGATION_MASK	Indicates that the profile is rejected because of bad navigation reading. This flag is not currently being used.
0000 0000 0001 0001	BAD_HEADING	PD_PROFILE_BAD_GYRO_MASK	Indicates that the profile is rejected because of bad gyro reading. This flag is not currently being used.
0000 0000 0010 0001	BAD_ROLL	PD_PROFILE_BAD_ROLL_MASK	Indicates that the profile is rejected because of bad roll reading. This flag is not currently being used.
0000 0000 0100 0001	BAD_PITCH	PD_PROFILE_BAD_PITCH_MASK	Indicates that the profile is rejected because of bad pitch reading. This flag is not currently being used.
0000 0000 1000 0001	BAD_HEAVE	PD_PROFILE_BAD_HEAVE_MASK	Indicates that the profile is rejected because of bad heave reading. This flag is not currently being used.
0000 0001 0000 0001	BAD_DEPTH_CORRECTOR	PD_PROFILE_BAD_DRAFT_MASK	This is set by the merge function, and indicates that the profile is rejected

GSF Ping Flags	Description	Proposed HDCS Mapping	Comment
			because vessel draft cannot be interpolated.
0000 0010 0000 0001	BAD_TIDE_CORRECTOR	PD_PROFILE_BAD_TIDE_MASK	Indicates that the profile is rejected because of bad tide reading. This flag is not currently being used.
0000 0100 0000 0001	BAD_SVP	PD_PROFILE_BAD_SVP_MASK	This is a mirror of the bit in the observed depths file, where the SV correction functions are implemented. It indicates that the profile is rejected because of interpolation errors during the SV correction procedure.
0000 1000 0000 0001	NO_POSITION	PD_PROFILE_REJECTED_MASK	Indicates that the profile has been rejected. It implies that all soundings within the profile are also rejected.
0001 0000 0000 0000	DELAYED_HEAVE_APPLIED	No flag to be applied to HDCS files upon import from GSF.	
0010 0000 0000 0000	GPSZ_APPLIED	No flag to be applied to HDCS files upon import from GSF.	
0100 0000 0000 0000	Combined with bit 15 represents applied tide type	No flag to be applied to HDCS files upon import from GSF.	
1000 0000 0000 0000	Combined with bit 14 represents applied tide type	No flag to be applied to HDCS files upon import from GSF.	