

**GEOLOGICAL SURVEY OF CANADA**

**OPEN FILE xxxx**

**SEGYLib - An XML-Enabled .NET C# Library used to Read, Write and Manipulate SEGY Files**

**R. C. Courtney**

**2016**

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**SEGYLib – An XML-Enabled .NET C# Library used to Read, Write and Manipulate SEGY Files**

**R. C. Courtney**

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SEGYLib V1.0 – A .NET C# Library used to Read and Write SEGY Files

# Abstract

SEGYlib V1.0 is a Microsoft C# class library that can be used in the family of Visual Studio products to read and write SEG-Y files up to and including Revision 1 (Norris and Faichney, 2002). SEG-Y files are one of the formats established by the Society of Exploration Geophysicists to standardize the storage of single-channel and multichannel seismic data. The SEG-Y standard is in the process of revision and the library released here should be capable of extension to new revisions without a complete rewrite.

This library can be used interchangeably in the Microsoft suite of Visual Studio Tools, include Visual C#, F#, Visual Basic, and Visual C++ projects. This library can also be loaded as .NET assemblies in Windows-implementations of Matlab and Python. Both the code and the complied libraries are included in this release. It is a work in progress and this release represents a preliminary functionality for reading and writing SEGY files.

The class library is structured to support the serialization of SEGY contents to and from XML. Entire SEGY files, SEG-Y File header and individual SEG-Y traces can be read and written in XML format, facilitating scanning of SEG-Y files for metadata harvesting.

Keywords: seismic data, SEG-Y, C#, Visual Basic, Matlab, Python, XML

# Introduction

The GSC has been collecting digital seismic data since the early 1990’s and has used and continues to use SEG-Y (Norris and Faichney, 2002) as its primary format for storing its digital seismic, sounder and sidescan data. Earlier efforts at the Geological Survey of Canada Atlantic had developed computer code written in C and C++ languages to read and write SEGY files up to Revision 0 (Barry et al., 1975). Although these routines can still be used, they suffer from a range of issues from a programming perspective. The older code is not object-oriented so the extension, or modification, of the code often involves awkward and substantial rewrites. Older code relied heavily on direct pointer manipulation for memory allocation and access; it is well known that this approach often results in memory leaks and code overwrites. As program complexity increases, these problems sometimes present significant barriers to progress and stable programming.

Modern coding techniques rely on an object-oriented (OOP) approach where these pitfalls can be addressed. In OOP, memory allocation and deallocation are strictly controlled, abstracted from the physical memory in the system. Memory leaks are eliminated as garbage collection techniques actively dispose unused or discarded memory allocations. With proper modelling, the code becomes much more reusable and extendable. In addition, the use of structured objects leads readily to the concept of serialization and the expression of SEG-Y data in XML format, useful for harvesting metadata for data storage and dissemination.

Current versions of Visual Studio (as of 2015) are migrating away from using C++ as a primary programming language, so it was decided to code this effort in C# using object oriented programming techniques. It was decided to update the core code libraries to handle SEG-Y formatted data up to version 1 (Norris and Faichney, 2002),laying a better-structured foundation for the eventual upgrade to Revision 2.

# Implementation

The SEG-Y file structure is well documented and made available through the SEG (Norris and Faichney, 2002). The reader is strongly recommended to read this reference before proceeding. The SEG-Y standard has undergone two revisions (Barry et al., 1975; Norris and Faichney, 2002) in the last 40 years, maintaining essential file and byte-level structure compatibility between revisions. It is anticipated by the author that this compatibility will be maintained through future revisions.

A SEG-Y file comprises a sequence of byte stream blocks, the structure of each strictly defined through the standard. The byte order of the file is generally big endian, however little endian versions do exist.

*File Header Section:*

*Block 1 : 3200 byte Textual header - Traditionally IBM EBCDIC –encoded text header information. The SEG-Y standard does not explicitly state EBCDIC, and ASCII is often encountered. This implementation supports both ASCII and EBCDIC.*

*Block 2 : 400 byte Binary File Header as described in the standard.*

*Block 2+i : Extended Textual Header for i = 0, n . SEG-Y Revision 1 supports extended text blocks. This implementation supports from 0 to n extended text blocks. A variable text block designation ( -1) is not supported at the time.*

*Trace Section – sequence repeated for each encoded trace*

*Block j - 240 byte binary trace header as described in the standard .*

*Block j+1 - trace data as described in the standard.*

A class library was written to allow structured accesses to these file contents and to also permit parts, or the whole, of the SEGY file to be written in XML format to aid metadata harvesting. The following section details the framework of the implementation released in this open file.

# Class Hierarchy

SEGYFile

SEGYFileHeader

SEGYTrace

SEGYTraceHeader

SEGYTraceData

ExtendedTextHeader

SEGYTraceData

Fig. 1 Class Hierarchy

The SEGY-Y has been structured into a treed class structure that strongly reflects the byte stream blocked structure upon which it was derived. The byte stream blocks from the source file are stored directly in byte arrays within the class structure in their original byte order (big-endian or little endian). The SEGY attributes are accessed through properties that dynamically access these original byte organized block structures. This feature allows a structured pathway for the reinterpretation of SEGY attributes that will allow the user to accommodate local variations in the implementation of the SEG-Y standard by different vendors and organizations.

# Release Details

The Visual Studio project tree containing source code and the compiled class library are included in this release as open source for unrestricted general use. The code only relies on one open source external library ( URL: <http://www.codeproject.com/Articles/492449/Transform-between-IEEE-IBM-or-VAX-floating-point>) used to convert to and from IBM floating point format. This portion is subject to the Code Project Open License (CPOL) 1.02 (<http://www.codeproject.com/info/cpol10.aspx>) which is unrestrictive to any application. This release also contains an XML schema that can be used to validate XML instances of SEGYlib.

The release is in either zip or CD/DVD format and the file structure is as follows:

|  |  |  |
| --- | --- | --- |
| **Name** | **Path** | **Remarks** |
| SEGYlib.dll | SEGYLib\Release | .Net 4.5 library for SEGYlib |
| Converters.dll | SEGYLib\Release | .Net 4.5 library for IBM floating point converter |
| SEGYlib | SEGYLib | C# source tree for SEGYlib (VS2013) |
| Converters | SEGYLib | C# source tree for Converters (VS2013) |
| SEGYLib.docx | SEGYLib | MS Office 2010 version of this document |
| SEGYLib.pdf | SEGYLib | PDF version of this document |
| SEGYlib Library Reference Manual.docx | SEGYLib | MS Office 2010 version of the complete library reference manual |
| SEGYlib Library Reference Manual.pdf | SEGYLib | PDF version of the complete library reference manual |
| SEGYlib Library Reference Manual.chm | SEGYLib | Microsoft Compiled HTML Help version of the complete library reference manual |
| SEGYlib.xsd | SEGYLib | XML schema of SEGY output |
| SEGYLibInstall.zip | SEGYLib | Microsoft Install Package for SEGYLib |

# Description of Class Library

A description of the main objects of the library follows:

## SEGYFile

This class is primary interface to read and write SEGY rev 1 formatted files. The details of the public properties, fields and methods can be found in attached library reference guide.

The **SEGYFile** type exposes the following members.

## Constructors

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [SEGYFile](#_4AD9BF68_Topic) | Initializes a new instance of the **SEGYFile** class |

## Properties

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public property | [currentTrace](#_8D37552F_Topic) | last trace read from file |
| Public property | [FileHeader](#_17874466_Topic) | access to File Header Class |
| Public property | [NumberOfTracesInBuffer](#_7148EDD9_Topic) | number of traces in Trace list |
| Public property | [Traces](#_B35343B3_Topic) | List of traces including data and trace headers |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [AddTrace](#_38925B88_Topic) | add a trace to the end of the Traces list |
| Public method | [Close](#_5A70417B_Topic) | close I/O channels |
| Public method | [CopyAllTraces](#_3C0841C1_Topic) | make a deep copy of the Traces List |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GoToStartOfTrace](#_863430F8_Topic) | position the stream reader/writer at the start of the n'th trace |
| Public method | [isSEGY](#_64BCE4A7_Topic) | test to see if input file is a SEGY file |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [MoveFilePointerToStartOfTraces](#_E08127CE_Topic) | move file pointer to the end of the file header blocks |
| Public method | [Open](#_57C30FAD_Topic) | open or create a SEGY file returns 0 if unsuccessful; 1 if non zero length file ; 2 is empty file |
| Public method | [ReadAllTraceHeaders](#_FE2916C_Topic) | read all trace headers but don't load trace data |
| Public method | [ReadAllTraces](#_6EDBF0C0_Topic) | read all trace headers including trace data |
| Public method | [ReadFileHeader](#_9061BF7_Topic) | read the file headers |
| Public method | [ReadNextTrace](#_185766A1_Topic) | read the next trace in the file |
| Public method | [ReadNTraces](#_BC851DC8_Topic) | read the next n traces in the file |
| Public methodStatic member | [ReadXML](#_457A5EB_Topic) | read an SEGY file in XML format |
| Public methodStatic member | [ReadXMLFileHeader](#_A647BBD4_Topic) | read an SEGY file header in XML format |
| Public methodStatic member | [ReadXMLTrace](#_3B656085_Topic) | read an SEGY trace in XML format |
| Public method | [ReindexTracePositions](#_D339817C_Topic) | re-read the file and reindex the trace locations |
| Public method | [RemoveAllTraces](#_51644E44_Topic) | delete all trace storage |
| Public method | [RemoveTrace](#_D4853204_Topic) | remove trace i from the Traces list |
| Public method | [SkipNTracesOnRead](#_F6E4BAB9_Topic) | skip ntraces |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [Write(String)](#_30EB19DA_Topic) | write the entire file to disk |
| Public method | [Write(SEGYFileHeader)](#_47DE64F6_Topic) | write the file header to disk |
| Public method | [Write(SEGYTrace)](#_4E811FD4_Topic) | write a trace to disk |
| Public method | [Write(List(SEGYTrace))](#_AB571614_Topic) | write the list Traces to disk |
| Public method | [WriteXML(String)](#_F798B4E8_Topic) | write the file to XML |
| Public method | [WriteXML(String, SEGYFileHeader)](#_EC3201B8_Topic) | write the file header to XML |
| Public method | [WriteXML(String, SEGYTrace)](#_A740B142_Topic) | write the trace to XML |

## Fields

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public field | [isBigEndian](#_5C5C6506_Topic) | true for big endian file; false little endian |

## Sample Usage of SEGYFile

Read an entire file

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

string inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(inputFileName);

if( !sf.isSEGY() )

{

sf.Close();

return;

}

sf.ReadAllTraces();

Read only trace headers in case the file is excessive is length

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

string inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(inputSEGYfile);

if( !sf.isSEGY() )

{

sf.Close();

return;

}

sf.ReadAllTraceHeaders();

Read only trace headers in case the file is excessive is length – use this form if you want to use progress bars

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

string inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(inputSEGYfile);

sf.MoveFilePointerToStartOfTraces();

sf.Traces = new List<SEGYlib.SEGYTrace>();

while (sf.ReadNextTrace())

{

SEGYlib.SEGYTrace tr = sf.currentTrace;

tr.Data = d;

tr.TraceData.TraceDataBuffer = null; // dump the trace data

sf.Traces.Add(tr);

c++;

// put progress bar update her

}

sf.Close();

Create a new SEGY file from using an existing one as a template

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(this.openFileDialog1.FileName); // open an existing SEGY file

if( !sf.isSEGY() )

{

sf.Close();

return;

}

SEGYlib.SEGYFile sf2 = new SEGYlib.SEGYFile(); // create a new SEGY file

sf2.Open(outputFileName);

sf2.FileHeader = sf.FileHeader.Copy(); // copy the input trace header

sf2.Write(sf2.FileHeader); // write out the header

while ( sf.ReadNextTrace())

{

SEGYlib.SEGYTrace tr = sf.currentTrace;

SEGYlib.SEGYTrace newTr = tr.Copy();

newTr.sourcePositionX = newx; // do some operations on the traceheader

newTr.sourcePositionY = newy;

if ( this.checkBoxCreateMillisecondField.Checked)

{

newTr.TraceHeader.lagTimeBMsec = (short) millisecondsCorrectionsToShotTime[c];

newTr.TraceHeader.timeBasis = (ushort)millisecondsCorrectionsToShotTime[c];

}

sf2.Write(newTr);

}

sf.Close();

sf2.Close();

Write out a trace in XML format

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(this.openFileDialog1.FileName); // open an existing SEGY file

if( !sf.isSEGY() )

{

sf.Close();

return;

}

sf.ReadNextTrace());

sf.WriteXML(“text.xml”, sf.currentTrace);

sf.Close();

# SEGYFileHeader Class

Class used for storing and retrieving data stored in the SEGY file Header

The **SEGYFileHeader** type exposes the following members.

## Constructors

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [SEGYFileHeader](#_EAC7D017_Topic) | constructor |

## Properties

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public property | [amplitudeRecoveryMethod](#_750D004E_Topic) | attribute defined though segy rev 1 standard |
| Public property | [BinaryFileHeader](#_7029EEB1_Topic) | access to byte block of Binary File header |
| Public property | [binaryGainRecovered](#_CF156A45_Topic) | attribute defined though segy rev 1 standard |
| Public property | [correlatedDataTraces](#_5991347A_Topic) | attribute defined though segy rev 1 standard |
| Public property | [dataSampleFormatCode](#_9374032C_Topic) | attribute defined though segy rev 1 standard |
| Public property | [ensembleFold](#_A3FCB536_Topic) | attribute defined though segy rev 1 standard |
| Public property | [ExtendedTextHeader](#_D693DA4F_Topic) | lead 3200 byte tape header plus any other extended blocks |
| Public property | [fixedLengthTraceFlag](#_507F6EB8_Topic) | attribute defined though segy rev 1 standard |
| Public property | [impulseSignalPolarity](#_480DB560_Topic) | attribute defined though segy rev 1 standard |
| Public property | [jobIdentificationNumberz](#_2D964A8E_Topic) | attribute defined though segy rev 1 standard |
| Public property | [lengthOfFileHeader](#_653A7AE8_Topic) | byte length of file header including extended tape header and binary file header |
| Public property | [lineNumber](#_6BFE33D3_Topic) | attribute defined though segy rev 1 standard |
| Public property | [measurementSystem](#_7D71173B_Topic) | attribute defined though segy rev 1 standard |
| Public property | [numberOfAuxilaryTracesPerEnsemble](#_E6B0EFF7_Topic) | attribute defined though segy rev 1 standard |
| Public property | [numberOfDataTracesPerEnsemble](#_F345CF73_Topic) | attribute defined though segy rev 1 standard |
| Public property | [numberOfExtendedTextualFileHeaderRecordsFollowing](#_734B1C24_Topic) | attribute defined though segy rev 1 standard |
| Public property | [numberOfSamplesPerDataTrace](#_7CE05E91_Topic) | attribute defined though segy rev 1 standard |
| Public property | [numberOfSamplesPerDataTraceForOriginalFieldRecording](#_A62FFE81_Topic) | attribute defined though segy rev 1 standard |
| Public property | [reelNumber](#_9B2E933_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sampleIntervalInMicroseconds](#_75F4EDF4_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sampleIntervalInMicrosecondsInOriginalFieldRecording](#_19A689E4_Topic) | attribute defined though segy rev 1 standard |
| Public property | [segyFormatRevisionNumber](#_4ED6FF45_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepCode](#_28099909_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepFrequencyEnd](#_7C7B3C37_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepFrequencyStart](#_BA53434B_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepLength](#_B6D6C63A_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepTraceTaperLengthAtEnd](#_3C0B5AEB_Topic) | attribute defined though segy rev 1 standard |
| Public property | [sweepTraceTaperLengthAtStart](#_35822711_Topic) | attribute defined though segy rev 1 standard |
| Public property | [taperType](#_96CEA6F7_Topic) | attribute defined though segy rev 1 standard |
| Public property | [traceNumberSweepChannel](#_C43986FC_Topic) | attribute defined though segy rev 1 standard |
| Public property | [traceSortingCode](#_E0A9EE0A_Topic) | attribute defined though segy rev 1 standard |
| Public property | [verticalSumCode](#_B1477B4B_Topic) | attribute defined though segy rev 1 standard |
| Public property | [vibratoryPolarityCode](#_C32699AC_Topic) | attribute defined though segy rev 1 standard |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [Copy](#_1D7135CC_Topic) | make a deep copy of the Header |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetFileHeaderText](#_A8503AC9_Topic) | get a string for the extended tape header |
| Public method | [GetFileHeaderTextByLine](#_EF922777_Topic) | get the Text header by 80 character lines |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [isBigEndian](#_D5B0682A_Topic) | true for big endian and false for little endian |
| Public method | [isFileHeaderASCII](#_120C4D66_Topic) | is the file header encoded with ASCII or EBCDIC |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [ReadFileHeader](#_98066D51_Topic) | read the file header from disk |
| Public method | [SetFileHeader](#_30003FD9_Topic) | set the Text Header by 80 character line |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [WriteFileHeader](#_B2F8F45_Topic) | write the file header to disk |

## Fields

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public field | [isSEGYFileHeaderAscii](#_38070616_Topic) | true if Text Header is ASCII; false if EBCDIC |
| Public field | [positionOfStartOfDataTraces](#_BC8E10A6_Topic) | file position of start of trace data |

## Sample Usage of SEGYFileHeader

Examine parts of the file header

SEGYlib.SEGYFile sf = new SEGYlib.SEGYFile();

string inputSEGYfile = this.openFileDialog1.FileName;

sf.Open(inputSEGYfile);

if( !sf.isSEGY() )

{

sf.Close();

return;

}

string head = sf.FileHeader.GetFileHeaderText(0); // get the first header data

int code = sf.FileHeader.dataSampleFormatCode ; //read header value

# SEGYTrace Class

SEGYTrace is used to access and set SEGY rev 1 trace data

## Properties

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public property | [codedTime](#_72ED43B_Topic) | trace time in DDDHHHMMSSmmm |
| Public property | [Data](#_136E3687_Topic) | signal amplitude |
| Public property | [groupPositionXGSCDIG](#_A24DC0C2_Topic) | GSCA implementation of group position |
| Public property | [groupPositionYGSCDIG](#_D4A94E30_Topic) | GSCA implementation of group position |
| Public property | [isBigEndian](#_A6976861_Topic) | true if big endian |
| Public property | [isLatLon](#_AC78C502_Topic) | is it a lat/lon position or projected |
| Public property | [positionOfTraceInFile](#_14D17532_Topic) | position in bytes |
| Public property | [sourcePositionX](#_BF60BB5_Topic) | source position X corrected for scaling factors |
| Public property | [sourcePositionY](#_D5ED49B5_Topic) | source position Y corrected for scaling factors |
| Public property | [timeTracedRecorded](#_A216ED57_Topic) | DateTime of trace instance |
| Public property | [totalLengthOfTraceData](#_A3DBE1AC_Topic) | total number of bytes of trace data in including trace header |
| Public property | [TraceData](#_DB68C9A4_Topic) | access to underlying Trace Data Class |
| Public property | [TraceHeader](#_8E195EFB_Topic) | access to underlying Trace Header Class |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [Copy](#_3385B011_Topic) | make a deep copy of a SEGY Trace |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [FixMsecField](#_EA9812FB_Topic) | transcribe msec field in old GSC format the old GSC formatted files used the Time Basis Field 166-167 for storing msec field should use lag b or lag A field this copies 166-167 to 106-107 |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [Intialize](#_280BB5E2_Topic) | initilize trace structure |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [Write](#_70982223_Topic) | write a trace to a BinaryWriter stream |

# SEGYTraceData Class

SEGYTraceData allows access to the contents of the binary trace data

The **SEGYTraceData** type exposes the following members.

## Constructors

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [SEGYTraceData](#_70061EBD_Topic) | SEGYTraceData allows access to the contents of the binary trace data |

## Properties

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public property | [Data](#_283DBE77_Topic) | a double precision view of the trace data use this to read and change the contents of the trace data buffer |
| Public property | [DataCopy](#_ECDE3424_Topic) | Use this if you want to change the data values as SEGYTraceData.Data always returns values in the trace data buffer |
| Public property | [TraceDataBuffer](#_44CB7C64_Topic) | access to byte[] trace data block |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [Initialize](#_510C9C6B_Topic) | Initialize the class |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |

# SEGYTraceHeader Class

The **SEGYTraceHeader** type exposes the following members.

## Constructors

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [SEGYTraceHeader](#_CF3074BF_Topic) | SEGYTraceHeader is used to access and change contents of the binary trace header data block |

## Properties

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public property | [aliasFilterSlopeDBOctave](#_67046EAF_Topic) | refer to SEGY rev 1 documentation |
| Public property | [aliasFrequencyHz](#_4D802DAB_Topic) | refer to SEGY rev 1 documentation |
| Public property | [bigEndian](#_12628735_Topic) | true if big endian |
| Public property | [coordinateUnits](#_2DC9301E_Topic) | refer to SEGY rev 1 documentation |
| Public property | [correlated](#_C9E25A0B_Topic) | refer to SEGY rev 1 documentation |
| Public property | [crossLineNumber3D](#_15D82575_Topic) | refer to SEGY rev 1 documentation |
| Public property | [dataUse](#_D726EB17_Topic) | refer to SEGY rev 1 documentation |
| Public property | [datumElevationAtReceiverGroup](#_57AD495_Topic) | refer to SEGY rev 1 documentation |
| Public property | [datumElevationAtSource](#_7E65CF40_Topic) | refer to SEGY rev 1 documentation |
| Public property | [dayOfYear](#_4B96C782_Topic) | refer to SEGY rev 1 documentation |
| Public property | [delayRecordingTimeMsec](#_7964CFD4_Topic) | refer to SEGY rev 1 documentation |
| Public property | [deviceTraceIdentifier](#_FF7C480D_Topic) | refer to SEGY rev 1 documentation |
| Public property | [distanceFromCenterOfSourcePointToCenterOfGroup](#_C41BCC03_Topic) | refer to SEGY rev 1 documentation |
| Public property | [energySourcePointNumber](#_BFCD3EB_Topic) | refer to SEGY rev 1 documentation |
| Public property | [ensembleNumber](#_ECC5C0D7_Topic) | refer to SEGY rev 1 documentation |
| Public property | [gainTypeOfFieldInstruments](#_2AFF8B49_Topic) | refer to SEGY rev 1 documentation |
| Public property | [gapSize](#_DC49763A_Topic) | refer to SEGY rev 1 documentation |
| Public property | [geophoneGroupNumberofLastTraceWithinOriginalFieldRecord](#_F394A767_Topic) | refer to SEGY rev 1 documentation |
| Public property | [geophoneGroupNumberOfRollSwitchPositionOne](#_EDB07501_Topic) | refer to SEGY rev 1 documentation |
| Public property | [geophoneGroupNumberofTraceNumberOneWithinOriginalFieldRecord](#_A3C26015_Topic) | refer to SEGY rev 1 documentation |
| Public property | [groupCoordinateX](#_F8D2FBEF_Topic) | refer to SEGY rev 1 documentation |
| Public property | [groupCoordinateY](#_A8A3D849_Topic) | refer to SEGY rev 1 documentation |
| Public property | [groupStaticCorrectionMsec](#_5B134FEC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [highCutFrequencyHz](#_766628E2_Topic) | refer to SEGY rev 1 documentation |
| Public property | [highCutSlopeDBOctave](#_3797D601_Topic) | refer to SEGY rev 1 documentation |
| Public property | [hourOfDay](#_DD09B99A_Topic) | refer to SEGY rev 1 documentation |
| Public property | [inLineNumber3D](#_1029CCAD_Topic) | refer to SEGY rev 1 documentation |
| Public property | [instrumentEarlyOrIntialGainDB](#_D9EFFA98_Topic) | refer to SEGY rev 1 documentation |
| Public property | [instrumentGainConstantDB](#_22C33763_Topic) | refer to SEGY rev 1 documentation |
| Public property | [lagTimeAMsec](#_C40E26E6_Topic) | refer to SEGY rev 1 documentation |
| Public property | [lagTimeBMsec](#_8FA9198B_Topic) | refer to SEGY rev 1 documentation |
| Public property | [lowCutFrequencyHz](#_B06A592E_Topic) | refer to SEGY rev 1 documentation |
| Public property | [lowCutSlopeDBOctave](#_A1EFB3EC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [minuteOfHour](#_F6627BF5_Topic) | refer to SEGY rev 1 documentation |
| Public property | [muteTimeEndTimeMsec](#_2C910E7C_Topic) | refer to SEGY rev 1 documentation |
| Public property | [muteTimeStartTimeMsec](#_4C2907C4_Topic) | refer to SEGY rev 1 documentation |
| Public property | [notchFilterSlopeDBOctave](#_4F626AFC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [notchFrequencyHz](#_B45A33FD_Topic) | refer to SEGY rev 1 documentation |
| Public property | [numberOfHorizonatallySummedTracesYieldingThisTrace](#_71DF2E1_Topic) | refer to SEGY rev 1 documentation |
| Public property | [numberOfSamplesInTrace](#_997B5B10_Topic) | refer to SEGY rev 1 documentation |
| Public property | [numberOfVerticallySummedTracesYieldingThisTrace](#_A2494C48_Topic) | refer to SEGY rev 1 documentation |
| Public property | [originalFieldRecordNumber](#_49077951_Topic) | refer to SEGY rev 1 documentation |
| Public property | [overTravel](#_8D338C9D_Topic) | refer to SEGY rev 1 documentation |
| Public property | [receiverGroupElevation](#_C3D32E94_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sampleIntervalUsec](#_221ACEB_Topic) | refer to SEGY rev 1 documentation |
| Public property | [scalarAppliedToShotPointNumber](#_5B8CA857_Topic) | refer to SEGY rev 1 documentation |
| Public property | [scalarForAllElevationsAndDepths](#_3E0AC4F0_Topic) | refer to SEGY rev 1 documentation |
| Public property | [scalarToBeAppliedToAllCoordinates](#_A514CB1D_Topic) | refer to SEGY rev 1 documentation |
| Public property | [scalarUsedToScaleTraceHeaderMSecTimes](#_1424EEFC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [secondOfMinute](#_2DAC0AE3_Topic) | refer to SEGY rev 1 documentation |
| Public property | [shotpointNumber](#_F36FE86E_Topic) | refer to SEGY rev 1 documentation |
| Public property | [souceStaticCorrectionMsec](#_AE5925CB_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceCoordinateX](#_C202E602_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceCoordinateY](#_A2227FE3_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceDepthBelowSurface](#_E3C9F62A_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceEnergyDirectionExponent](#_826048E7_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceEnergyDirectionMantissa](#_42587D50_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceMeasurementExponent](#_2D0EEF87_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceMeasurementMantissa](#_5084E8D9_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceMeasurementUnit](#_F5A7779_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sourceType](#_75CDE9A8_Topic) | refer to SEGY rev 1 documentation |
| Public property | [subweatheringVelocity](#_5397862F_Topic) | refer to SEGY rev 1 documentation |
| Public property | [surfaceElevationAtSource](#_45D9CE88_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepFrequencyAtEnd](#_59B748F3_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepFrequencyAtStart](#_2A300C59_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepLengthInMsec](#_705F9A83_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepTaperLenghtAtEndMsec](#_1AE24016_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepTaperLengthAtStartMsec](#_B86A7BDC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [sweepType](#_B9220484_Topic) | refer to SEGY rev 1 documentation |
| Public property | [taperType](#_3A17D93B_Topic) | refer to SEGY rev 1 documentation |
| Public property | [timeBasis](#_8F1184C8_Topic) | refer to SEGY rev 1 documentation |
| Public property | [totalStaticMsec](#_B5E0E8AD_Topic) | refer to SEGY rev 1 documentation |
| Public property | [TraceHeaderBuffer](#_3389049B_Topic) | SEGYTraceHeader storage block |
| Public property | [traceIdentificationCode](#_6D20F04_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceNumberWithinEnsemble](#_36FF5B22_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceNumberWithinOriginalFieldRecord](#_1E7CC6A1_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceSequenceNumberWithinFile](#_BE9DE2B1_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceSequenceNumberWithinLine](#_4DFF6B9C_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceValueMeasurementUnit](#_1AB92AA2_Topic) | refer to SEGY rev 1 documentation |
| Public property | [traceWeightingFactor](#_FA7C5B56_Topic) | refer to SEGY rev 1 documentation |
| Public property | [transductionConstantExponent](#_F924656A_Topic) | refer to SEGY rev 1 documentation |
| Public property | [transductionConstantMantissa](#_4A786468_Topic) | refer to SEGY rev 1 documentation |
| Public property | [transductionUnits](#_7D8B797A_Topic) | refer to SEGY rev 1 documentation |
| Public property | [upholeTimeAtGroupMsec](#_93A1B54F_Topic) | refer to SEGY rev 1 documentation |
| Public property | [upholeTimeAtSourceMsec](#_31931EDC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [waterDepthAtGroup](#_E66790EA_Topic) | refer to SEGY rev 1 documentation |
| Public property | [waterDepthAtSource](#_B64F4DC_Topic) | refer to SEGY rev 1 documentation |
| Public property | [weatheringVelocity](#_113957A9_Topic) | refer to SEGY rev 1 documentation |
| Public property | [xCoordinateOfEnsemble](#_554E5B1B_Topic) | refer to SEGY rev 1 documentation |
| Public property | [yCoordinateOfEnsemble](#_B5FDF44_Topic) | refer to SEGY rev 1 documentation |
| Public property | [yearDataRecorded](#_56226E96_Topic) | refer to SEGY rev 1 documentation |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [Initialize](#_58220C61_Topic) | initialize object |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |

# SEGYUtilities Class

SEGYUtilities for use in reading and writing SEGY files

The **SEGYUtilities** type exposes the following members.

## Constructors

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public method | [SEGYUtilities](#_B7918C9F_Topic) | Initializes a new instance of the **SEGYUtilities** class |

## Methods

|  |  |  |
| --- | --- | --- |
|  | Name | Description |
| Public methodStatic member | [Bytes2Int](#_F969481C_Topic) | convert bytes to long int |
| Public methodStatic member | [ConvertAsciiToEbcdic](#_26AA8F04_Topic) | convert an ASCII byte array to an EBCDIC byte array |
| Public methodStatic member | [ConvertEbcdicToAscii](#_EEF98F2D_Topic) | convert an EBCDIC byte array to an ASCII byte array |
| Public methodStatic member | [convertPositionToint](#_9A2384E6_Topic) | convert a position to a SEGY trace header integer |
| Public methodStatic member | [convertToPosition](#_D45B0B39_Topic) | convert a SEGY trace header positional value to position |
| Public methodStatic member | [decimalDegreesToDMS](#_1A08E272_Topic) | convert decimal degrees to degrees-minutes-seconds |
| Public methodStatic member | [degreesToSecondsOfArc](#_6BAE6BDD_Topic) | convert decimal degrees to seconds of arc |
| Public methodStatic member | [dmsToDecimalDegrees](#_8D42F0AB_Topic) | convert degrees-minutes-seconds to decimal degrees |
| Public method | [Equals](http://msdn2.microsoft.com/en-us/library/bsc2ak47) | Determines whether the specified [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b) is equal to the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Protected method | [Finalize](http://msdn2.microsoft.com/en-us/library/4k87zsw7) | Allows an object to try to free resources and perform other cleanup operations before it is reclaimed by garbage collection. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetHashCode](http://msdn2.microsoft.com/en-us/library/zdee4b3y) | Serves as a hash function for a particular type. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public method | [GetType](http://msdn2.microsoft.com/en-us/library/dfwy45w9) | Gets the [Type](http://msdn2.microsoft.com/en-us/library/42892f65) of the current instance. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public methodStatic member | [Int2Bytes](#_3DB1D82B_Topic) | convert a long int to bytes |
| Protected method | [MemberwiseClone](http://msdn2.microsoft.com/en-us/library/57ctke0a) | Creates a shallow copy of the current [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b). (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |
| Public methodStatic member | [secondsOfArctoDegrees](#_324E4916_Topic) | convert seconds of arc to decimal degrees |
| Public method | [ToString](http://msdn2.microsoft.com/en-us/library/7bxwbwt2) | Returns a string that represents the current object. (Inherited from [Object](http://msdn2.microsoft.com/en-us/library/e5kfa45b).) |

# Extending Class for Local Variants to SEGY Standard

In the past, some organizations have used fields in the binary file header and/or the binary trace headers to store information not conforming to the published SEGY standard. This class structure can be easily amended by adding a property to the relevant class that gets and sets data from the stored byte array blocks.

For example, to retrieve and set source coordinate X positions from the header, the following property is written the SEGYTraceHeader class:

/// <summary>

/// refer to SEGY rev 1 documentation

/// </summary>

public int sourceCoordinateX

{

get

{

// 72 is the byte location in the header, 4 is the wordlength of an int

return (int)SEGYUtilities.Bytes2Int(this.iTraceHeaderBuffer, 72, 4, true, isBigEndian);

}

set

{

SEGYUtilities.Int2Bytes((long)value, true, this.iTraceHeaderBuffer, 72, 4, isBigEndian);

}

}

which uses the SEGYUtilities method, Bytes2Int and Int2Bytes, to retrieve and store this information in the trace header byte array block.

The GSC had stored non-conformant positional information in the trace header in the group coordinate X location in the trace header byte array block. This non-conformant property is retrieved by adding the following to the SEGYTrace class:

/// <summary>

/// GSCA implemententation of group position

/// </summary>

public double groupPositionXGSCDIG

{

get

{

return SEGYUtilities.convertToPosition(this.iSEGYTraceHeader.groupCoordinateX, 3, -1e6);

}

set

{

}

}

An updated schema can be regenerated using the Microsoft’s XML Schema Definition Tool, XSD.exe

References

Barry, K., Cavers, D., and Kneale, C., 1975, Recommended standards for digital tape formats: Geophysics, v. 40, p. 344-352.

Norris, M., and Faichney, A., 2002, SEG Y rev 1 Data Exchange format: Technical Standards Commitee SEG (Society of Exploration Geophysicists).

# Appendix 1 – XML Schema for SEGYlib

<?xml version="1.0" encoding="utf-8"?>

<xs:schema elementFormDefault="qualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">

<xs:element name="SEGYFile" nillable="true" type="SEGYFile" />

<xs:complexType name="SEGYFile">

<xs:sequence>

<xs:element minOccurs="1" maxOccurs="1" name="isBigEndian" type="xs:boolean" />

<xs:element minOccurs="0" maxOccurs="1" name="FileHeader" type="SEGYFileHeader" />

<xs:element minOccurs="0" maxOccurs="1" name="Traces" type="ArrayOfSEGYTrace" />

<xs:element minOccurs="1" maxOccurs="1" name="NumberOfTracesInBuffer" type="xs:int" />

<xs:element minOccurs="0" maxOccurs="1" name="currentTrace" type="SEGYTrace" />

</xs:sequence>

</xs:complexType>

<xs:complexType name="SEGYFileHeader">

<xs:sequence>

<xs:element minOccurs="1" maxOccurs="1" name="positionOfStartOfDataTraces" type="xs:long" />

<xs:element minOccurs="1" maxOccurs="1" name="isSEGYFileHeaderAscii" type="xs:boolean" />

<xs:element minOccurs="0" maxOccurs="1" name="ExtendedTextHeader" type="ArrayOfBase64Binary" />

<xs:element minOccurs="0" maxOccurs="1" name="BinaryFileHeader" type="xs:base64Binary" />

<xs:element minOccurs="1" maxOccurs="1" name="dataSampleFormatCode" type="xs:int" />

<xs:element minOccurs="1" maxOccurs="1" name="jobIdentificationNumberz" type="xs:unsignedInt" />

<xs:element minOccurs="1" maxOccurs="1" name="lineNumber" type="xs:unsignedInt" />

<xs:element minOccurs="1" maxOccurs="1" name="reelNumber" type="xs:unsignedInt" />

<xs:element minOccurs="1" maxOccurs="1" name="numberOfDataTracesPerEnsemble" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="numberOfAuxilaryTracesPerEnsemble" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sampleIntervalInMicroseconds" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sampleIntervalInMicrosecondsInOriginalFieldRecording" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="numberOfSamplesPerDataTrace" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="numberOfSamplesPerDataTraceForOriginalFieldRecording" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="ensembleFold" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="traceSortingCode" type="xs:short" />

<xs:element minOccurs="1" maxOccurs="1" name="verticalSumCode" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepFrequencyStart" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepFrequencyEnd" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepLength" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepCode" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="traceNumberSweepChannel" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepTraceTaperLengthAtStart" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="sweepTraceTaperLengthAtEnd" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="taperType" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="correlatedDataTraces" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="binaryGainRecovered" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="amplitudeRecoveryMethod" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="measurementSystem" type="xs:unsignedShort" />

<xs:element minOccurs="1" maxOccurs="1" name="impulseSignalPolarity" type="xs:unsignedShort" />

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<xs:element minOccurs="1" maxOccurs="1" name="segyFormatRevisionNumber" type="xs:unsignedShort" />

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