LAS 3.0

Log ASCII Standard
Document #1 – File Structures

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LAS Version 3.0 Discussion

The LAS format began with the desire for a simple format to exchange well log data. The world-wide acceptance of LAS proved the need for such a format. As users embraced the concept and the format, many new applications of the concept were attempted. As data users, we have all been tempted to put more data into our LAS files than the format was originally designed to handle. This led to the realization that LAS needed to expand.

LAS 3.0 was originally proposed as an update to LAS 2.0, with just minor changes to handle more well log data, such as multiple logging runs. But, like a ball rolling down a hill, the process quickly gained speed. What we are now presenting is a major redesign of the LAS format. We have maintained the founding principles of LAS, and those using LAS 3.0 for log data alone will find that the format is much the same as previous versions. However, those wishing to use LAS 3.0 for other data types will find in this format the expanded flexibility to accurately and completely describe their data.

Originally LAS was designed around a collection of file "sections". Each section began with a title line, and that title line was marked with a tilde ("~") at the beginning of the line. This design has been maintained, and we have added several new sections, plus added the rules for adding user-defined sections.

The standard will be released in two major parts. This first part will describe the file STRUCTURES, including those defined to hold the new data types, and the details of how to build a LAS ver 3.0 file.

The next part of the LAS 3.0 release will describe specific CONTENT requirements. These content requirements will describe the exact sections, parameters, and channels that will satisfy the specific needs of each group or organization that wishes to define a LAS 3.0 content requirements.

To introduce the new structure concepts, remember that in previous versions of LAS the following sections were required: **~Version**, **~Well**, **~Curve** and **~ASCII**. The **~Version** section contains only data related to the LAS file. This section is still required in LAS 3.0, and now has additional options added. The **~Well** section contains all data that is common to every data set related to that specific well, including the well identification and location. This section has been maintained and expanded.

The remaining sections in an LAS file will be defined by the data set or sets being included. In general terms they will follow the pattern of a Parameter section, Definition section, and a Data section for each data set. This is consistent with the historical **~Parameter**, **~Curve** and **~ASCII** sections used for log data. While these section names have been maintained for log data, the equivalent sections for new data sets will follow this new naming convention:

~Section_Parameter, ~Section_Definition, and ~Section_Data.

Some data sets will require all three of these section, others may only require a Parameter section, or a combination of Definition and Data sections.

A LAS 3.0 file might contain just one data set, such as logs or core, or it could contain a number of data sets. Whichever option is chosen, there must only be one `~Version` section, and one `~Well` section. These sections must also be the first two sections in the file, and in this order. After that, each data set should appear as a set. For example, the **~Parameter**, **~Curve**, and **~ASCII** sections must appear together. Likewise **~Core_Parameter**, **~Core_Definition**, and **~Core_Data** must appear together.

The future has been designed into the new version of LAS. Using the following two data models, provision has been made to allow users to define new sections as the need arises. These new sections should fit either of the following cases:

1) Self-contained Sections, such as the **~Well** Information and **~Parameter** sections. (Note: In most cases the **~Parameter** sections are related to other data sections.) Following this example, the new section would look something like this:

~NewSection_Parameter

```
Name .Unit                    Data  : Description   {F} | Association
```

2) Data Sections with related Definition and optional Parameter sections. These sections will follow the **~Parameter**, **~Curve**, **~ASCII** model where **~Parameter**s contains header information related to the log data, **~Curve** contains the definitions of the log curves present, and **~ASCII** contains an indexed table of log digits.

```
~NewSection_Parameter

 Para1 .Unit                  Data  : Description   {F} | Association

~NewSection_Definition

 Index .Unit                  Data  : Description   {F} | Association
 Chan1 .Unit                  Data  : Description   {F} | Association


~NewSection_Data | NewSection_Definition

1234.00,5678.00
1234.25,6789.00
1234.50,7890.00
```

The Parameter sections are optional, and should only be used for data that is directly relevant to the type of data intended for that section.

In all cases, user-defined sections must follow the same structure rules set out for the defined sections in this document.

What's new in LAS Ver 3.0

This is a short list of the new features in Ver 3.0

1. New Data types. (Core, Drilling etc).
2. "Structure" rules separated from "Content" rules.
3. New delimiters and structures.
4. Comma Tab and Space delimited data.
5. Handles 1D, 2D and 3D arrays
6. Supports Multiple Runs.
7. Parameter Zoning.
8. Floating point, string, integer, Date and Time formats supported.
9. Addition of User defined data is easy
10. WRAP YES has been dropped.
11. ~Other section has been dropped.

Conventions Used in this Document.

If it looks like this;	It means this:
`BS.IN     8.25 : Bit Size`	Text that appears in this non-proportional font style indicates example text that is an excerpt from a LAS file.
~~`BS . IN	-8.25 ; Bit Size {F}`~~	Text that appears in this non-proportional font with the wavy underline is an example LAS content that violates the LAS 3.0 standard in some way. This is used in examples to illustrate common errors.
Parameter Data	Text that appears in this font style is a LAS 3.0 related term defined in the LAS 3.0 document. A definition for these phrases can be found in Appendix III.
`BS   .Unit     Value : Description`	Text that appears in this Italics style of this non-proportional font style indicates a placeholder for the actual file contents that would appear in that position, defined by the word in italics. In this example the file would contain an actual unit for BS, such as INCH, not the word `Unit`.

Major Components of a LAS Ver 3.0 File

LAS Files are divided into logical sections. Sections are recognized by lines that begin with the ~ (tilde, ASCII 126) character. These section defining lines are called **Section Title lines**. Specific sections are recognized by their names, which follow the ~(tilde) character. The entire word following the ~ is the section name, not just the first character after the ~.

Sections contain lines where data is described and/or stored. There are several types of sections and several types of lines within sections.

The LAS 3.0 standard defines which combinations of sections must exist in LAS files, and in which order. For example, the **~Version** and **~Well** section must exist in that order in all Ver 3.0 LAS files.

As in LAS version 2.0, only one well will be described within a single file.

Data is stored as one, two or three dimensional arrays. The data are usually indexed to depth or time, but may be presented as discrete measurements if required.

Data is grouped by type into related sections, as they relate to the well in which that data was acquired. Types include depth and time indexed Logging, Core, Inclinometry, Drilling, Formation tops, test data, user defined types, etc.

Primary Section Types

Parameter Data Sections

Contains any number of **Parameter Data** lines (see below). Intended to hold One dimensional data that relates in general to one of the data types described.

Column Definition Sections

Contains any number of **Column Definition** lines (see below). Intended to hold detailed descriptions (name, unit, etc) of each 2D or 3D channels stored in a **Column Data** section. There is always a matching **Column Data** section.

Column Data Sections

Contains any number of **Column Data** lines (see below). Intended to hold 2D and 3D indexed and non-indexed channels. There is always a matching **Column Definition** section that fully describes each channel. There may also be a matching **Parameter Data** section that holds related parameters.

User Defined Sections

Other types of sections can be defined as the user needs. Always use the above three primary types whenever possible. See the section on **Adding User Defined Data** for additional details.

Lines Types Within Sections

Parameter Data Lines

Appear in **Parameter Data** sections.

Each **Parameter Data** line contains a one dimensional data item consisting of (usually but not restricted to) one or two elements. Each line also contains a full description of that data.

Some **Parameter Data** lines are required in certain sections. Some of these required **Parameter Data** lines must also contain data, while other do not. Later sections discussing specific sections will state specific requirements.

Note: Required implies the **Parameter Data** line for each listed item must exist, consisting of the Mnemonic, unit (if applicable), and description. The **Value** field for each required **Parameter Data** line does not have to filled in for LAS compliance. The exception to this rule It is strongly recommended that

Column Definition Lines

Appear only in **Column Definition** sections.

Although structurally identical to a **Parameter Data** lines (see above), each **Column Definition** line is used to describe each matching (by order) channel contained in the matching **Column Data** section. The name, unit, log code, description and format (if used) contained in each **Column Definition** line fully describe the channel it refers to.

Column Data Lines

Appear only in **Column Data** sections.

Each line contains a series of delimited data values. The delimiting character is defined by the value of the `DLM` parameter in the `~Version` section. Descriptions of each data are contained in the matching **Column Definition** section.

Structure Details

The details of the sections and the lines within the sections are discussed.

Sections

The **~Version** and **~Well** sections must appear in every LAS 3.0 file as the first and second sections respectively.

Other sections are grouped by data type. Each group consists of two or three sections; a **Parameter Data** section (optional for all but Log data), a **Column Definition** section, and a **Column Data** section, in that order.

For example, core analysis data would have the following three sections:

```
~Core_Parameter
~Core_Definition
~Core_Data.
```

At least one group or data type of either the defined LAS 3.0 data types or a user defined type must exist in every LAS 3.0 file.

The **Column Definition** and the **Column Data** sections for each data type are matched sets and must both appear in that order. The corresponding **Parameter Data** section is optional (except for Log data), but if used must appear before it's corresponding **Column Definition** Section.

LAS 3.0 defines six specific well related data types and their root Section Title names. They are:

```
~Ascii or ~Log
~Core
~Inclinometry
~Drilling
~Tops
~Test
```

Additional data types can be defined by the user and content rules discussed elsewhere in the document may define other section titles.

Stand alone user defined **Parameter Data** sections can be included. Care must be taken to use standalone **Parameter Data** sections only when the data contained does not fit into any of the other defined data types.

When used, the section order of each set of the three sections for each data type must be Parameter, Definition, then Data.

Blank lines and comment lines can appear within **Column Data** sections, but can only appear BEFORE the first **Column Data** line of that section, or after the LAST **Column Data** line of that section.

The names of each channel can optionally appear above each channel as a comment line immediately before, after or on the section title line of that section if space allows.

Note: Do not use the **~Other** section recognized by LAS ver 2.0. It is no longer allowed in LAS 3.0. Any data that can be stored in such a section, must now be stored properly in a user defined **Parameter Data** or **Column Data** section.

Lines Within Sections

Section Title Lines

First non-space character of the line must the ~ (tilde, ASCII 126) character.

The identifying **Section Title** is all characters from the first character after the ~ (tilde) until the next space, the next | (bar) character, or the end of that line.

Parameter Data section titles must be named by appending the suffix `_Parameter` to the root **Section Title** such as `~Core_Parameter.`

Column Definition section titles must be named by appending the suffix `_Definition` to the root **Section Title** such as `~Core_Definition.`

Column Data section titles must be named by appending the suffix `_Data` to the root **Section Title** such as `~Core_Data.`

Sections that are exceptions to the required suffix additions are the `~Parameter,` `~Curve` and `~ASCII` sections, which implies logging data.

The **Column Data Section Title** line must include an association to its matching **Column Definition** section.

Do this by first placing a | (bar, ASCII 124) character after the **Section Title**, then adding the full matching **Column Definition** section title (without the ~ tilde), such as;

`~Core_Data | Core_Definition`

This gives a reliable way of knowing which **Column Definition** section belongs with this **Column Data** section.

Note: No other section title lines other than a Data Section title line may use the association delimiter (|) followed by other section titles.

The **Section Title line** must contain at least the ~ (tilde) and a section title.
The character immediately after the ~ (tilde) must not be a space, i.e. the section title must begin immediately after the ~ (tilde).

If the bar character and matching **Column Definition** section title are included, then that matching **Column Definition** section must exist in the LAS file.

Any number of spaces can separate the section title and | (bar) delimiter and the matching **Column Definition** section title.

Parameter Data Lines

Each **Parameter Data** line consists of at least four, and up to six delimited fields. Each field has a defined name. Some fields may only contain spaces if not needed (such as Unit).

`MNEM.UNIT        VALUE : DESCRIPTION  {Format} | Assoc1,Assoc2 …`

Delimiting characters and the following rules are used to separate the fields. Full descriptions of the delimiters can be found in Appendix II.

Each section should have the first period and last colon, and all other delimiting characters and fields aligned for each of reading, but this is not a requirement, nor is having the same alignment of the delimiters in all sections.

Note: Do not use TAB characters on a **Parameter Data** line in an attempt to space out the items. Use Spaces only for this purpose. Tabs are reserved for use as delimiting characters, and may only be used on **Parameter Data** lines as delimiters between multiple **Value** field data items or to delimit **Association** Parameters.

MNEMONIC (MNEM)

Any length >0, but must not contain periods, colons, embedded spaces, tabs, { }. [ ], | (bar) characters, leading or trailing spaces are ignored. It ends at (but does not include) the first period encountered on the line.

UNIT (if data has a unit)

Any length, but must not contain colons, embedded spaces, tabs, {} or | characters. If present, it must begin at the next character after the first period on the line. The Unit ends at (but does not include) the first space or first colon after the first period on the line.

VALUE (may be required or optional)

Any length, but must not contain colons, {} or | characters. If the Unit field is present, at least one space must exist between the unit and the first character of the **Value** field. The **Value** field ends at (but does not include) the last colon on the line.

The **Value** field can contain more than one piece of data. Each piece must be delimited by the character defined in the `DLM` (Data Delimiting Character) parameter in the `~Version` section.

Individual data items that themselves contain the delimiting character, must each be entirely surrounded by a single pair of quotes " " (ASCII 34 each). No data item can contain a pair of double quote characters "" (ASCII 34 twice).

DESCRIPTION

Any length. Begins as the first character after the last colon on the line, and ends at the last { (left brace), or the last | (bar), or the end of the line, whichever is encountered first.

FORMAT (optional)

Contained within the last set of matching {} (left and right braces). If you do not want to specify a format, then do not use a matched set of {} within the DESCRIPTION field or an error may result if the characters within the {} are not proper format characters.

If the format field is absent, this implies that any numerical data referred to by this line must be in floating point format.

ASSOCIATION(s) (optional)

The Associations field contains one or more mnemonics found elsewhere in the LAS file on **Parameter Data** or **Column Definition** lines. Those lines hold related pieces of information to the data found on this line.

Association mnemonics are listed after the last | (bar) character on the line, delimited by the `DLM` character for multiple mnemonics. Each Association mnemonic used must be found somewhere else in the LAS file as a legal mnemonic on a **Parameter Data** line or **Column Definition** line.

Column Data section lines and comments cannot contain associated parameters.

Column Definition Lines

Column Definition Lines are identical in structure to **Parameter Data** lines and share all rules discussed for **Parameter Data** lines. They do not carry data, rather they fully describe each data channel in the matching **Column Data** section elsewhere in the file. The order is most critical and must be the same as the order of the columns of data in the referenced **Column Data** section.

Column Data Lines

Column Data lines contain delimited data values on each line of a **Column Data** section.

Column Data Lines can be of any length and contain any number of data items. If the **Column Definition** for any data item has a format { } specified (Floating point, integer, etc), then all data items must be formatted using that specified format.

Each line must contain the same number of delimiting characters, which is one less than the number of data items. The number of data items must match the number of **Column Definition** lines found in the matching **Column Definition** section.

Each column of data must be separated by exactly one delimiting character specified in the **Value** field of the `DLM` parameter found in the `~Version` section. If the delimiter is the SPACE character, then continuous space characters are to be taken as a single delimiter.

Comma and Tab delimited files only: Data items may be absent at any level, as indicated by two consecutive delimiter characters. The value of this missing data item must be taken as the NULL value described in the `~Well` section by the NULL parameter. For space delimited files, data items cannot be absent. The NULL value must be used.

Data items that themselves contain the delimiting character, must each be entirely surrounded by a single pair of quotes " " (ASCII 34 each). No data item can contain a pair of double quote characters "" (ASCII 34 twice).

Cases where two or more consecutive delimiters (except space delimiters) occur, the missing data channel inferred between each delimiter shall be interpreted as the NULL value as defined in the `~Well` section Null parameter.

`1000.00,13.45,46.0985,,,`

is equivalent to

`1000.00,13.45,46.0985,-999.25, -999.25, -999.25`

If a **Column Data** line has an indexed channel as the first channel, then that first data item cannot be blank or null, regardless of the delimiting character.

Individual Section Descriptions

Required sections

~Version

The `~Version` section identifies information pertaining the file itself.

The `~Version` section must be the first section of every LAS 3.0 file. It is classified as a **Parameter Data** section, and must conform to the basic rules that apply to all **Parameter Data** sections.

`VERS, WRAP` and `DLM` must be the first **Parameter Data** lines of the section. All other **Parameter Data** lines must contain data that relates to the LAS standard or the file itself, never to the well. Well related information must be placed in other appropriate sections.

No association mnemonics are allowed. Comment lines and blank lines are allowed.

Any other **Parameter Data** lines as defined by user need or future standards compliance definitions may also be present, but must come AFTER the three required parameters.

Required Contents (All files)

Three **Parameter Data** lines are required. The **Value** field of each must contain one of the indicated or optional values.

```
        VERS.              3.0  : LAS Version Identifier


        WRAP.               No  : WRAP mode


        DLM .           SPACE   : Column Data Section Delimiter
   OR
        DLM .           COMMA   : Column Data Section Delimiter
   OR
        DLM .             TAB   : Column Data Section Delimiter
```

The delimiting characters referred to by the `SPACE`, `Comma` and `Tab` words are ASCII 32 for `Space`, ASCII 44 for `Comma` and ASCII 9 for `Tab`.

Note: if the `DLM` **Value** field has no value, then Space delimiting is assumed by default.

Details Specific to the ~Version section

Column Data sections no longer have line length restrictions. This removes the need to define a way to write multiple lines for each index step, as previously defined in LAS ver 2.0 using the WRAP YES parameter. `NO` is the only legal LAS 3.0 value for WRAP.

The **Value** used for `DLM` must be one of the three possible words listed above. Never use the actual ASCII characters described by the words for the **Value** field.

All **Column Data, Parameter Data,** and **Column Definition** sections in the LAS file must use the same and actual ASCII character (not the word) as described by `DLM`'s value for delimiting data.

Each single delimiter character represents the division between each successive column of any **Column Data** section or **Value** field on a **Parameter Data** line. The only exception to this is the SPACE delimiter, where consecutive space characters are considered one delimiter.

If the delimiter is Tab or Comma, then the number of delimiter characters for every index step must be exactly one less than the number of channels being included. If the

delimiter is space, then at least one space delimiter must exist between each column at all index levels.

Cases where two or more consecutive delimiters (except space delimiters) occur, the missing data channel inferred between each delimiter shall be interpreted as the NULL value as defined by the `Null` parameter's **value** field found in the `~Well` section.

`1000.00,13.45,46.0985,,,`

is equivalent to

`1000.00,13.45,46.0985,-999.25, -999.25, -999.25`

If a **Column Data** line has an index (first) channel, then that channel cannot be left empty.

~Well

The `~Well` section contains data that uniquely identifies the Well bore data.

Required Contents (All files)

The following eleven **Parameter Data** lines are required in every `~Well` section. The **Value** field of the `STRT, STOP, STEP` and `NULL` parameters must contain data. All other **Value** fields are not required to contain data but it is strongly recommended that all **Parameter Data** lines contain correct data.

`STRT, STOP` and `STEP` **value** fields must contain the actual first, last and increment values of the index channel in the `~ASCII` or the `~Log_Data` section (if present, and if there is only one `~Log_Data` section).

If the file contains more than one `~Log_Data` section, then the `STRT, STOP` and `STEP` value fields must have the correct data for `~Log_Data[1]`. Other sections `~Log_Data[n]` sections do not require additional `STRT, STOP` and `STEP` parameters at this time.

STEP must be 0 if step increment is not exactly constant between every index.

```
STRT .              Value     : First Index Value
STOP .              Value     : Last Index Value
STEP .              Value     : STEP of index
```

The `NULL` value requires a value. –999.25 or –99999 are common examples.

```
NULL .              Value     : NULL VALUE
```

The Well identification, location and ownership parameters are as follows;

```
COMP .                        : Company
WELL .                        : Well
FLD  .                        : Field
LOC  .                        : Location
SRVC .                        : Service Company
CTRY .                        : Country
```

`CTRY` value must be a valid internet country code.

```
DATE .                        : Service Date
```

X/Y location co-ordinate parameters are required. The **Value** fields are optional. There are two possible sets of parameters which must be used. Either set is acceptable, but each set must be complete.

(Either)

```
LATI .                          : Latitude
LONG .                          : Longitude
GDAT .                          : Geodetic Datum
```

(OR)

```
X    .                          : X or East-West coordinate
Y    .                          : Y or North South coordinate
GDAT .                          : Geodetic Datum
HZCS .                          : Horizontal Co-ordinate System
```

If Country (CTRY) has the value of **ca**, (Canada) then these three **Parameter Data** lines must be included.

```
PROV .                          : Province
UWI  .                          : UNIQUE WELL ID
LIC  .                          : License Number
```

If Country (CTRY) has the value of **us**, (USA), then these three **Parameter Data** lines must be included.

```
STAT .                          : State
CNTY .                          : County
API  .                          : API NUMBER
```

If Country (CTRY) has the no **Value**, then neither of these sets is required. The user can add similar data applicable to the country in use.

Details Specific to the ~Well Section

No associations are allowed for any defined mnemonic in the **~Well** section.

~Well must be the second section of every LAS 3.0 file. It may contain only **Parameter Data** lines, comments and blank lines. Any user added **Parameter Data** lines must come after all defined or required lines.

The **STRT**, **STOP** and **STEP** parameter data lines must always appear as the first three lines of the **~Well** section.

The **STRT** value must be exactly that of the FIRST index value (first column) in the **~ASCII** section or **~Log_Data** section.

The **STOP** value must be exactly that of the LAST index value (first column) in the **~ASCII** section or **~Log_Data** section.

The **STOP** parameter can have a value of NULL (the same value as listed as the value of the **NULL** Parameter). This is necessary to accommodate an emerging need of real time data acquisition where data files are being constantly updated. See Appendix V on Real time Data Allowances for details. This rule only applies if the **~ASCII** section is used for Log data.

The **STEP** value must be the exact value of the difference between every index value of the first channel of the **~ASCII** section or **~Log_Data** section. Where the **STEP** increment is not a constant difference between successive index values, the **STEP** must be have the value of zero.

An excellent source of Geodetic datum and Horizontal Coordinate System parameter values (**GDAT** and **HZCS)** is the EPSG database of geodetic information Check: **http://www.petroconsultants.com/products/geodetic.html** for further details.

The **CTRY** parameter value, if present, must be one of the two letter Internet country codes appropriate to the country in which the well is located. Check:

http://www.ics.uci.edu/pub/websoft/wwwstat/country-codes.txt

or search the internet for "Country Codes". Several sources are available.

If **CTRY** has is a value other than **ca** or **us,** then neither of the above indicated **Parameter Data** line sets or any other additional parameters are required.

The **DATE** value format must either be specified in a format field on that line, or the {DD/MM/YYYY} format will be taken as the default

Data Section Sets

Each of the following six defined data type section sets are optional, but at least one set must exist in each LAS 3.0 file. The **Parameter Data** section of each set is optional except the **~Parameter** or **~Log_Parameter** sections if Log data is present.

Log Data Section(s)

Log data is defined and stored in the **~Parameter, ~Curve**, and **~ASCII** sections (for those who wish to continue with Ver 2.0 guidelines) **or** in complete sets of **~Log_Parameter, ~Log_Definition** and **~Log_Data** sections.

If Log data is stored in a LAS 3.0 file and the file contains only the **~ASCII** section (no **~Log_Data** sections), then the **~ASCII** section must the last section of the file.

If Log data is stored in a LAS 3.0 file and the file contains only a single **~Log_Data** section (no **~ASCII** section), then the **~Log_Data** section must the last section of the file.

If Log data is stored in a LAS 3.0 file and the file contains more than one **~Log_Data** section, then all **~Log_Data[n]** sections must the last sections of the file.

~Parameter, ~Curve and ~ASCII as well as **~Log_Parameter, ~Log_Definition** and **~Log_Data** are reserved LAS Ver 3.0 section names. Only the **~Log_Parameter, ~Log_Definition** and **~Log_Data** sections can have multiple sections in the same file. (**~Log_Data[n]** etc). **~Parameter, ~Curve and ~ASCII** section titles must not use [n] index suffixes.

~Parameter or ~Log_Parameter

The **~Parameter** or **~Log_Parameter** sections are the **Parameter Data** sections that corresponds to Log Parameters. All rules that apply to **Parameter Data** sections apply to these sections.

The **Section Title line** must look exactly like these options with possible [n] suffix as appropriate for multiple **~Log_Parameter** sections.

```
~Parameter
~Log_Parameter
~Log_Parameter[n]
```

The parameters associated with each group of logging data are listed in the **~Parameter** or **~Log_Parameter** sections. An example of the section contents might look like this.

```
PDAT .              : Permanent Data
APD  .Unit          : Above Permanent Data
DREF .              : Depth Reference (KB,DF,CB)
EREF .Unit          : Elevation of Depth Reference
RUN  .              : Run Number
```

~Curve or ~Log_Definition

The **~Curve** or **~Log_Definition** sections are the **Column Definition** sections that corresponds to Log Definitions. All rules that apply to **Column Definition** sections apply to these sections.

These sections holds the **Column Definition**s for each of the data items in the **~ASCII** or **~Log_Data** sections. The **Section Title line**s must look exactly like these options with possible [n] suffix as appropriate for multiple **~Log_Definition** sections.

```
~Curve
~Log_Definition
~Log_Definition[n]
```

An example of the section contents might look like this.

```
DEPT.FT         Log Code : DEPTH
DPHI.PU         Log Code : DENSITY POROSITY
GR  .GAP        Log Code : GAMMA RAY
PEF .           Log Code : PHOTOELECTRIC FACTOR
RHOB.G/C3       Log Code : BULK DENSITY
```

~ASCII or ~Log_Data

The **~ ASCII** or **~Log_Data** sections are the **Column Data** sections that corresponds to Log data. All rules that apply to **Column Data** sections apply to these sections. They hold the indexed log data values. The **Section Title line**s must look exactly like these with possible [n] suffix as appropriate for multiple **~Log_Data** sections.

```
~ASCII | Curve
~Log_Data | ~Log_Definition
~Log_Data[n] | ~Log_Definition[n]
```

The | (bar) delimiter must be used with the ~Log_Data section to comply with the new **Column Data** section title association rules. The association section title can be left off of the **~ASCII** section title. The **~Curve** section is then assumed to be the matching **Column Definition** section.

An example of the section contents might look like this.

```
3264.50000      -5.65000    146.25214       3.34967       2.74322
```

or

```
3264.50000,-5.65000,146.25214,3.34967,2.74322
```

The first channel of the **~ASCII** or **~Log_Data** section must be the index of the other channels. The index channel must be continuously increasing or decreasing.

Core Data Sections

Three new sections are designed to hold Core data.

~Core_Data, ~Core_Definition ~Core_Parameter are reserved LAS Ver 3.0 section names. Multiple sections can have Index extensions to each of the three sections ([1], [2] etc)

These sections are not mandatory. If any are present, then all must be present.

~Core_Parameter

The **~Core_Parameter** section is a **Parameter Data** section. All rules that apply to **Parameter Data** sections apply to this section.

The parameters associated with each group of core data are listed in the **~Core_Parameter** section. An example would look like this.

```
C_SRS  .                        : Core Source                {S}
C_TY   .                        : Core Type                  {S}
C_DT   .                        : Recovery Date (Date Core Cut) {D}
C_TP   .Unit                    : Core Top Depth             {F}
C_BS   .Unit                    : Core Base Depth            {F}
C_RC   .Unit                    : Recovered Amount (Length)  {F}
C_FM   .                        : Primary Formation Cored    {S}
C_DI   .Unit                    : Core Diameter              {F}
C_AC   .                        : Analyzing Company          {S}
C_AD   .                        : Analysis Date              {D}
```

~Core_Definition

The **~Core_Definition** section is a **Column Definition** section. This section holds the **Column Definition**s for each of the data items in the **~Core_Data** section. The **Section Title line** must look exactly like this with possible [n] suffix as appropriate for multiple sections.

```
~Core_Definition
```

An example of the section contents might look like this.

```
CORT   .Unit          : Core Top depth        {F}
CORB   .Unit          : Core Bottom Depth     {F}
PERM   .Unit          : Core permeability     {F}
CPOR   .Unit          : Core porosity         {F}
OIL    .Unit          : Core Oil saturation   {F}
SWTR   .Unit          : Core water saturation {F}
OILVOL.Unit           : Core oil volume       {F}
WTR    .Unit          : Core water volume     {F}
CDES   .              : Core description      {S}
```

~Core_Data

The **~Core_Data** section is a **Column Data** section. It holds the core data values. The **Section Title line** must look exactly like this with possible [n] suffix as appropriate for multiple sections.

```
~Core_Data | Core_Definition
```

An example of the section contents might look like this.

```
3460.0,3461.0,430.0,28.70,62.0,20.20,17.80,5.10,39.0,VfgrU SliShy
```

Inclinometry Data Sections

Three new sections are designed to hold Inclinometry data.

~Inclinometry_Data, ~Inclinometry_Definition, ~Inclinometry_Parameter are reserved LAS Ver 3.0 section names. Multiple sections can have Index extensions to each of the three sections ([1], [2] etc)

These sections are not mandatory. If any are present, then all must be present.

~Inclinometry_Parameter

The **~Inclinometry_Parameter** section is a **Parameter Data** section. All rules that apply to **Parameter Data** sections apply to this section.

The parameters associated with each group of Inclinometry data are listed in the **~Inclinometry_Parameter** section. An example would look like this.

```
I_DT  .               : SURVEY_DATE                                {D}
I_CO  .               : Recording Company                          {S}
I_RF  .Unit           : Depth Datum Elevation (from MSL)           {F}
I_AT  .               : Azimuth North Type (e.g. Grid/ True)       {S}
I_DC  .Unit           : Magnetic Declination (if I_AT not magnetic) {F}
I_KO  .Unit           : Kickoff Depth (M.D. of kickoff point)      {F}
I_GD  .               : Geodetic datum                             {S}
I_ONS .               : N/S Offset of well ref point to top hole   {F}
I_OEW .Unit           : E/W Offset of well ref point to top hole   {F}
```

The following additional parameters are required if eastings and northings and/or TVD are supplied in the file

```
I_CP .                : COMPUTE_METHOD (e.g. Radius of Curvature)  {S}
I_CS .                : COORDINATE_SYSTEM_NAME eg UTM18N            {S}
```

~Inclinometry_Definition

The **~Inclinometry_Definition** section is a **Column Definition** section. This section holds the Column Definitions for each of the data items in the **~Inclinometry_Data** section. The **Section Title line** must look exactly like this with possible [n] suffix as appropriate for multiple sections.

```
~Inclinometry_Definition
```

An example of the section contents might look like this.

```
MD   .Unit              : Measured Depth             {F}
TVD  .unit              : True Vertical Depth        {F}
AZIM .unit              : Borehole Azimuth           {F}
DEVI .unit              : Borehole Deviation         {F}
RB   .unit              : Borehole Relative Bearing  {F}
NSDR .unit              : North-South Drift          {F}
EWDR .unit              : East-West Drift            {F}
CLSR .unit              : Closure (horizontal) length {F}
```

~Inclinometry_Data

The `~Inclinometry_Data` section is a **Column Data** section. It holds the Inclinometry data values. The **Section Title line** must look exactly like this with possible [n] suffix as appropriate for multiple sections.

```
~Inclinometry_Data | Inclinometry_Definition
```

An example line in this section might look like this:

```
0.00,0.00,290.00,0.00,45,
100.00,100.00,234.00,0.00,45
200.00,198.34,284.86,1.43,45
```

Drilling Data Sections

Three new sections are designed to hold Drilling data.

`~Drilling_Data, ~Drilling_Definition ~Drilling_Parameter` are reserved LAS Ver 3.0 section names. Multiple sections can have Index extensions to each of the three sections ([1], [2] etc)

These sections are not mandatory. If any are present, then all must be present.

~Drilling_Parameter

The `~Drilling_Parameter` section is a **Parameter Data** section. All rules that apply to **Parameter Data** sections apply to this section.

The parameters associated with each group of Drilling data are listed in the `~Drilling_Parameter` section. An example would look like this.

```
RIG   .         BIG RIG : Drilling Rig name
CONTR .    DLR DRILLING : Contractor
```

~Drilling_Definition

The `~Drilling_Definition` section is a **Column Definition** section. This section holds the Column Definitions for each of the data items in the ~Drilling_Data section. The **Section Title line** must look exactly like this with possible [n] suffix as appropriate for multiple sections.

```
~Drilling_Definition
```

An example of the section contents might look like this.