



OpenOffice.org's Documentation of the Microsoft® Excel File Format

Excel Versions 2, 3, 4, 5, 95, 97, 2000, XP

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Project started	2001-Jun-29
Last change	2002-Aug-16

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1 Introduction

1.1 About This Document

This document contains a description of the binary file format of Microsoft Excel, including all available Excel versions (for Windows) from Excel 2.1 to the current Excel XP.

This project has been started in June 2001 and is still in progress. At several places the remark “2do” indicates an incomplete section of the documentation.

1.1.1 Project Status

Chapter	Contents	Status
1 Introduction	Common information	Done
2 Basic Substructures	Parts of records for common use	Done
3 Formulas	Structure of RPN token arrays and detailed description of all tokens	In progress
4 Worksheet/Workbook Structure	Abstract description of complex features represented by several records	In progress
5 Worksheet/Workbook Records	Detailed description of all records of the worksheet/workbook stream	In progress
6 Drawing Objects, Escher Layer		Not started
7 Charts		Not started
8 PivotTables		Not started
9 Change Tracking		Not started

1.1.2 Used Terms, Symbols and Formatting

- **References**

A reference to another chapter is symbolized by a little arrow: →1.1.

- **Examples**

An example is indented and marked with a light-gray border.

■ This is an example.

• Numbers

Numerical values are shown in several number systems:

Number system	Marking	Example
Decimal	None	1234
Hexadecimal	Trailing “H”	1234 _H
Binary	Trailing “2”	1001 ₂

Strings may contain specific values (control characters, unprintable characters). These values are enclosed in angle brackets.

Example of a string containing a control character: “abcdef<01_H>ghij”.

• Record listings

A record listing shows a bundle of records in the required order. A dark grey rectangle stands for a single record, a light gray rectangle stands for various records that do not matter in this context.

RECORD NAME	Record contents
	More uninteresting records

• Record content listings

Data offsets enclosed in squared brackets indicate record content that may be omitted (the remark “optional” may point out this).

The term “*Not used*” means: Ignore the data on import and write zero bytes on export. The same applies for unmentioned bits in bit fields.

The term “*Unknown*” describes data fields with fixed but unknown contents. On export these fields have to be written as shown.

1.2 File Format Versions

The Excel file format is named BIFF (Binary Interchange File Format). The following table shows which Excel version writes which file format.

Excel version	BIFF version	Document type	File format
Excel 2.1	BIFF2	Worksheet	Stream
Excel 3.0	BIFF3	Worksheet	Stream
Excel 4.0	BIFF4	Worksheet or workbook	Stream
Excel 5.0	BIFF5	Workbook	OLE2 storage
Excel 7.0 (Excel 95)	BIFF7	Workbook	OLE2 storage
Excel 8.0 (Excel 97)	BIFF8	Workbook	OLE2 storage
Excel 9.0 (Excel 2000)	BIFF8	Workbook	OLE2 storage
Excel 10.0 (Excel XP)	BIFF8X	Workbook	OLE2 storage

The oldest file format BIFF2 has of course the most restrictions. From BIFF4 on it is possible to store a bundle of sheets, called a workbook. The current format BIFF8 contains major changes towards older BIFF versions, for instance the handling of Unicode strings. Excel XP writes BIFF8X, an extension of BIFF8. Excel 97 and Excel 2000 can read BIFF8X, except the new features added with Excel XP. In this document the name “BIFF8” refers to both BIFF8 and BIFF8X, if BIFF8X is not mentioned explicitly.

1.3 Structure of a Worksheet File (BIFF2-BIFF4)

Files stored in the BIFF versions BIFF2 to BIFF4 contain all records for a sheet or a BIFF4 workbook in one simple stream. The records are arranged sequential, they are never embedded in other records.

1.4 Structure of a Workbook File (BIFF5-BIFF8)

An Excel workbook with several sheets (from BIFF5 on) is stored as an OLE2 Compound Document Format (OLE2 storage). It contains several streams for different types of data. A good documentation of the format of OLE2 storages can be found at  <http://jakarta.apache.org/poi/poifs/fileformat.html>. The document describes the file format of the POI file system (POIFS) which is compatible to OLE2 storages.

The following table lists names of possible streams.

Stream name	Contents
Book	BIFF5/BIFF7 workbook stream (→4.1.3)
Workbook	BIFF8 workbook stream (→4.1.3)
<05_h>SummaryInformation	Document settings
<05_h>DocumentSummaryInformation	Document settings
User Names	User names in shared workbooks (→9)
Revision Log	Change tracking log stream (→9)

The names of the streams SummaryInformation and DocumentSummaryInformation contain a leading byte with the value 05_h.

It is possible to create substorages like subdirectories in a file system, for instance for the PivotTable streams. These storages contain substreams itself.

Storage name	Contents
LNKxxxxxxxx	Storage for a linked OLE object (→6)
MBDxxxxxxxx	Storage for an embedded OLE object (→6)
_SX_DB_CUR	Pivot cache storage. The streams contain cached values for PivotTables (→8).
_VBA_PROJECT_CUR	Visual BASIC project storage

In all streams the records are arranged sequential, they are never embedded in other records. Exception in BIFF8: The Escher object stream is split and embedded in several MSODRAWING records (→6).

1.5 Structure of a Record

In an Excel data stream the data is divided into several records. Each record contains specific data for the various features of Excel. The common structure of a record is described in the following table.

Offset	Size	Contents	
0	2	Identifier	} Record header
2	2	Size of the following data (<u>sz</u>)	
4	<u>sz</u>	Data	

The maximum size of the record data is limited. If the size of the record data exceeds the given limits, one or more CONTINUE records (→5.14) will be added. Inside of a CONTINUE record the data of the previous record continues as usual.

In the following descriptions only the record data without the headers is shown. All offsets are relative to the beginning of the record data and not to the entire record. The contents of most of the records differ from version to version. This will be described in separate tables. A few older records are replaced in newer BIFF versions. Excel does not write these old records in these BIFF versions anymore.

1.6 Byte Order

All data items containing more than one byte are stored using the Little-Endian method. That means the least significant byte is stored first and the most significant byte last. This applies for all data types like 16-bit-integers, 32-bit-integers, floating-point values and Unicode characters. For instance the 32-bit-integer value 13579BDF_H is converted into the byte sequence $\text{DF}_\text{H} \text{ 9B}_\text{H} \text{ 57}_\text{H} \text{ 13}_\text{H}$.

2 Basic Substructures

This chapter contains information about substructures which are part of several records, for instance strings or error codes.

2.1 Byte Strings (BIFF2-BIFF7)

All Excel file formats up to BIFF7 contain simple byte strings. The byte string consists of the length of the string followed by the character array. The length is stored either as 8-bit-integer or as 16-bit-integer, depending on the current record. The string is not zero-terminated.

Offset	Size	Contents
0	1 or 2	Length of the string (character count) (l_n)
1 or 2	l_n	Character array (8-bit-characters)

2.2 Unicode Strings (BIFF8)

From BIFF8 on, strings are stored in a new Unicode format which allows reading and writing 16-bit-characters. The following tables describe the standard format, but in many records the strings differ from this format. This will be mentioned separately. It is possible (but not required) to store Rich-Text formatting information and extended information for Far-East inside of an Unicode string. This results in four different ways to store a string. The string is not zero-terminated.

2.2.1 Contents of an Unicode String

The string consists of the character count (as usual an 8-bit-integer or a 16-bit-integer), option flags, the character array and optional formatting information. If the string is empty, sometimes the option flags field will not occur. This is mentioned at the respective place.

- **Unicode string without additional information**

Offset	Size	Contents
0	1 or 2	Length of the string (character count) (l_n)
1 or 2	1	Option flags (see below): 00_H or 01_H
2 or 3	l_n or $2 \cdot \text{l}_n$	Character array (8-bit-characters or 16-bit-characters)

- Unicode string with Rich-Text formatting information

Offset	Size	Contents
0	1 or 2	Length of the string (character count) (<u>ln</u>)
1 or 2	1	Option flags (see below): 08 _H or 09 _H
2 or 3	2	Number of Rich-Text formatting runs (<u>rt</u>)
4 or 5	<u>ln</u> or 2· <u>ln</u>	Character array (8-bit-characters or 16-bit-characters)
var.	4· <u>rt</u>	List of <u>rt</u> formatting runs. Each run contains two 16-bit indexes:
Offset	Size	Contents
0	2	First formatted character (zero-based)
2	2	Index to FONT record (→5.27)

- Unicode string with Far-East information

Offset	Size	Contents
0	1 or 2	Length of the string (character count) (<u>ln</u>)
1 or 2	1	Option flags (see below): 04 _H or 05 _H
2 or 3	4	Far-East data size (<u>sz</u>)
6 or 7	<u>ln</u> or 2· <u>ln</u>	Character array (8-bit-characters or 16-bit-characters)
var.	<u>sz</u>	Unknown extended data about phonetic, keyboard, etc.

- Unicode string with Rich-Text and Far-East information

Offset	Size	Contents
0	1 or 2	Length of the string (character count) (<u>ln</u>)
1 or 2	1	Option flags (see below): 0C _H or 0D _H
2 or 3	2	Number of Rich-Text formatting runs (<u>rt</u>)
4 or 5	4	Far-East data size (<u>sz</u>)
8 or 9	<u>ln</u> or 2· <u>ln</u>	Character array (8-bit-characters or 16-bit-characters)
var.	4· <u>rt</u>	List of <u>rt</u> formatting runs. See above for details.
var.	<u>sz</u>	Unknown extended data about phonetic, keyboard, etc.

2.2.2 Option Flags

Bit	Mask	Contents	
0	01 _H	0 = 8-bit-characters	1 = 16-bit-characters
2	04 _H	0 = Contains no Far-East info	1 = Contains Far-East info
3	08 _H	0 = Contains no Rich-Text info	1 = Contains Rich-Text info

2.3 RK Values

An RK value is an encoded integer or floating-point value. RK values have a size of 4 bytes and are used to decrease file size for floating-point values.

Structure of an RK value (32-bit-value):

Bit	Mask	Contents	
0	00000001 _H	0 = Value not changed	1 = Value is multiplied by 100
1	00000002 _H	0 = IEEE floating-point value	1 = Integer value
31-2	FFFFFFF0 _H	Encoded value	

If bit 1 is cleared, the encoded value represents the 30 most significant bits of an IEEE floating-point value. The 34 least significant bits must be set to zero. If bit 1 is set, the encoded value represents a signed 30-bit-integer value. To get the correct integer, the encoded value has to be shifted right arithmetically by 2 bits.

If bit 0 is set, the decoded value (both integer and double) must be divided by 100 to get the final result.

Examples:

RK value	Decoded value	Result
3FF00000 _H	Floating-point = 1.0	1.0
3FF00001 _H	Floating-point = 1.0	0.01
004B5646 _H	Integer = 1234321	1234321
004B5647 _H	Integer = 1234321	12343.21

2.4 Error Codes

If the calculation of a formula results in an error or any other action fails, Excel sets a specific error code. These error codes are used for instance in cell records and formulas.

Error code	Error value	Description
00 _H	#NULL!	Intersection of two cell ranges is empty
07 _H	#DIV/0!	Division by zero
0F _H	#VALUE!	Wrong type of operand
17 _H	#REF!	Illegal or deleted cell reference
1D _H	#NAME?	Wrong function or range name
24 _H	#NUM!	Value range overflow
2A _H	#N/A!	Argument or function not available

2.5 List of Cached Values

The records CRN (→5.15) and EXTERNNAME (→5.23) and the formula token tArray (array constant, →3.10.1) require a list of constant values (floating-point values, strings, Boolean values or error codes). These values are stored as a simple list. The number of values is stored before in the respective record or token.

- IEEE floating-point value

Offset	Size	Contents
0	1	01 _H (Identifier for a floating-point constant)
1	8	IEEE floating-point value

- String value

A string value, BIFF2-BIFF7:

Offset	Size	Contents
0	1	02 _H (Identifier for a string constant)
1	var.	Byte string, 8-bit string length (→2.1)

A string value, BIFF8:

Offset	Size	Contents
0	1	02 _H (Identifier for a string constant)
1	var.	Unicode string, 16-bit string length, option flags occur always (→2.2)

- Boolean value

Offset	Size	Contents
0	1	04 _H (Identifier for a Boolean constant)
1	1	0 = FALSE, 1 = TRUE
2	7	Not used

- Error value

Offset	Size	Contents
0	1	10 _H (Identifier for an error constant)
1	1	Error code (→2.4)
2	7	Not used

2.6 Encoded Document Names

2.6.1 Encoded File Names

The intention of encoding file names is to make them more platform independent. Encoded file names occur in the records EXTERNSHEET (BIFF2-BIFF7, →5.24) or SUPBOOK (BIFF8, →5.56) and DCONREF (→5.16).

The first character of the file name is used to determine the type of encoding. In Unicode strings (BIFF8) this could be a 16-bit-value.

First character	Meaning
00 _H	Empty sheet name (nothing will follow)
01 _H	Encoded file name
02 _H	External reference to the own document (nothing will follow)
03 _H	External reference to a sheet in the own document (BIFF5/BIFF7)
others	Not encoded. This is the first character of the file name.

Inside of the encoded file name there can occur several control characters.

Control character	Meaning
01 _H	An MS-DOS drive letter will follow, or “@” and a server name in the local network
02 _H	Start path name on same drive as own document
03 _H	End of subdirectory name
04 _H	Start path name in parent directory of own document (may occur repeatedly)
06 _H	Start path name in startup directory of Excel
09 _H	Sheet in the same workbook (BIFF4)

Example: Own document is saved as “C:\path\own.xls”.

Formula	Encoded filename
=own.xls!A1	<02_h>
=Sheet2!A1	<01_h><09_h>Sheet2 (BIFF4 workbook)
=Sheet2!A1	<03_h>Sheet2 (BIFF5/BIFF7)
=[ext.xls]Sheet1!A1	<01_h>[ext.xls]Sheet1
= 'sub\[ext.xls]'Sheet1!A1	<01_h>sub<03_h>[ext.xls]Sheet1
= '\[ext.xls]'Sheet1!A1	<01_h><02_h>[ext.xls]Sheet1
= '\sub\[ext.xls]'Sheet1!A1	<01_h><02_h>sub<03_h>[ext.xls]Sheet1
= '\sub\sub2\[ext.xls]'Sheet1!A1	<01_h><02_h>sub<03_h>sub2<03_h>[ext.xls]Sheet1
= 'D:\sub\[ext.xls]'Sheet1!A1	<01_h><01_h>Dsub<03_h>[ext.xls]Sheet1
= '..\sub\[ext.xls]'Sheet1!A1	<01_h><04_h>sub<03_h>[ext.xls]Sheet1
= '\pc\sub\[ext.xls]'Sheet1!A1	<01_h><01_h>@pc<03_h>sub<03_h>[ext.xls]Sheet1

2.6.2 Encoded Document Names for DDE and OLE Object Links

A DDE link contains the name of the server application and the name of a document. An OLE object link contains a class name and a document name. In both cases the names are stored in one string, separated by the control character 03_h.

Example: A document contains a DDE link to the SO/OOo Calc document “example.sxc” and an OLE object link to the bitmap file “example.bmp”.

Link	Encoded document name
DDE	soffice<03_h>example.sxc
OLE object	Package<03_h>example.bmp

2.7 Line Styles for Cell Borders (BIFF3-BIFF8)

These line styles are used to define cell borders. The styles 08_h to 0D_h are available in BIFF8 only.

Index	Style	Sample	Index	Style	Sample
00_h	No line			The following for BIFF8 only:	
01_h	Thin	—————	08_h	Medium dashed	-----
02_h	Medium	—————	09_h	Thin dash-dotted	-·-----
03_h	Dashed	-----	0A_h	Medium dash-dotted	-·-----
04_h	Dotted	0B_h	Thin dash-dot-dotted	-.-·-----
05_h	Thick	—————	0C_h	Medium dash-dot-dotted	-.-·-----
06_h	Double	—————	0D_h	Slanted medium dash-dotted	-·-----
07_h	Hair			

2.8 Patterns for Cell Background Area (BIFF3-BIFF8)

From BIFF3 on, the cell background area may contain a pattern. Foreground and background colors of the pattern are defined separately. In the following table black is used as foreground color and white as background color.

Index	Pattern	Sample	Index	Pattern	Sample
00 _H		No background	0A _H		
01 _H			0B _H		
02 _H			0C _H		
03 _H			0D _H		
04 _H			0E _H		
05 _H			0F _H		
06 _H			10 _H		
07 _H			11 _H		
08 _H			12 _H		
09 _H					

2.9 Cell Attributes (BIFF2)

All cell records in BIFF2 contain a cell attribute field with a size of 3 bytes. They contain an index to an XF record (→5.59) and some repeated contents of the referenced XF record. The XF index field has a size of only 6 bits, so the index range is 0-63. If an index >62 is used, the XF index field always contains the value 63, and an IXFE record (→5.32) occurs in front of the cell record. It contains the correct index of the XF record.

Cell attributes field (3 bytes), BIFF2:

Offset	Size	Contents																					
0	1	Cell protection and XF index:																					
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>5-0</td><td>3F_H</td><td>Index to XF record (→5.59). The value 3F_H (63) indicates a preceding IXFE record (→5.32).</td></tr> <tr> <td>6</td><td>40_H</td><td>1 = Cell is locked</td></tr> <tr> <td>7</td><td>80_H</td><td>1 = Formula is hidden</td></tr> </tbody> </table>	Bit	Mask	Contents	5-0	3F _H	Index to XF record (→5.59). The value 3F _H (63) indicates a preceding IXFE record (→5.32).	6	40 _H	1 = Cell is locked	7	80 _H	1 = Formula is hidden									
Bit	Mask	Contents																					
5-0	3F _H	Index to XF record (→5.59). The value 3F _H (63) indicates a preceding IXFE record (→5.32).																					
6	40 _H	1 = Cell is locked																					
7	80 _H	1 = Formula is hidden																					
1	1	Indexes to FORMAT and FONT records:																					
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>5-0</td><td>3F_H</td><td>Index to FORMAT record (→5.28)</td></tr> <tr> <td>7-6</td><td>C0_H</td><td>Index to FONT record (→5.27)</td></tr> </tbody> </table>	Bit	Mask	Contents	5-0	3F _H	Index to FORMAT record (→5.28)	7-6	C0 _H	Index to FONT record (→5.27)												
Bit	Mask	Contents																					
5-0	3F _H	Index to FORMAT record (→5.28)																					
7-6	C0 _H	Index to FONT record (→5.27)																					
2	1	Cell style:																					
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>2-0</td><td>07_H</td><td>XF_HOR_ALIGN – Horizontal alignment (→5.59.1)</td></tr> <tr> <td>3</td><td>08_H</td><td>1 = Cell has left black border</td></tr> <tr> <td>4</td><td>10_H</td><td>1 = Cell has right black border</td></tr> <tr> <td>5</td><td>20_H</td><td>1 = Cell has top black border</td></tr> <tr> <td>6</td><td>40_H</td><td>1 = Cell has bottom black border</td></tr> <tr> <td>7</td><td>80_H</td><td>1 = Cell has shaded background</td></tr> </tbody> </table>	Bit	Mask	Contents	2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (→5.59.1)	3	08 _H	1 = Cell has left black border	4	10 _H	1 = Cell has right black border	5	20 _H	1 = Cell has top black border	6	40 _H	1 = Cell has bottom black border	7	80 _H	1 = Cell has shaded background
Bit	Mask	Contents																					
2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (→5.59.1)																					
3	08 _H	1 = Cell has left black border																					
4	10 _H	1 = Cell has right black border																					
5	20 _H	1 = Cell has top black border																					
6	40 _H	1 = Cell has bottom black border																					
7	80 _H	1 = Cell has shaded background																					

2.10 Cell Range Address Lists (BIFF8)

In BIFF8 there is a common way to store absolute cell range address lists in several records (not formulas). A cell range address list consists of a field with the number of ranges and the list of the range addresses. Each cell range address (called an ADDR structure) contains 4 16-bit-values.

Cell range address list, BIFF8:

Offset	Size	Contents
0	2	Number of following ADDR structures (nm)
2	$8 \cdot nm$	List of nm ADDR structures. Each structure represents a cell range:
Offset	Size	Contents
0	2	Index to first row
2	2	Index to last row
4	2	Index to first column
6	2	Index to last column

3 Formulas

3.1 Common Structure

Formulas are stored as part of a record, for instance inside of a FORMULA record or a NAME record. The common format of a formula is as follows:

Formula in BIFF2:

Offset	Size	Contents
0	1	Size of the following formula data (RPN token array) (<u>sz</u>)
1	<u>sz</u>	Formula data (RPN token array)

Formula in BIFF3-BIFF8:

Offset	Size	Contents
0	2	Size of the following formula data (<u>sz</u>)
2	<u>sz</u>	Formula data (RPN token array)

The contents of a formula are stored in the Reverse-Polish Notation (RPN). This means, first occur all operands of an operation, followed by the respective operator. The operands and operators are called tokens. For instance the simple term $1+2$ consists of 3 tokens. Written in RPN the formula is converted to the token list “1”, “2”, “+”. During parsing such an expression operands are pushed onto a stack. An operator pops the needed number of operands from stack, performs the operation and pushes the result back onto the stack.

Other examples for RPN token arrays:

Formula	Token array	Parsing result
$2 \cdot 4 + 5$	2, 4, “.”, 5, “+”	The “.” pops 4 and 2 and pushes 8, the “+” pops 5 and 8 and pushes 40 (the result).
$2 + 4 \cdot 5$	2, 4, 5, “.”, “+”	The “.” pops 5 and 4 and pushes 20, the “+” pops 20 and 2 and pushes 22 (the result).

A token can be a simple integer or floating point value, a string constant, a cell reference or cell range reference or an operator. A token is stored as follows:

Offset	Size	Contents
0	1	Token identifier
[1]	var.	(optional) Additional data for the token

Example of the formula for the term $1+2$:

Offset	Size	Data	Name	Comment
0	2	0007 _H	<u>sz</u>	Size of the following formula data
2	1	1E _H	tInt	{ Integer value token
3	2	0001 _H		}
5	1	1E _H	tInt	{ Integer value token
6	2	0002 _H		}
8	1	03 _H	tAdd	Addition operator

In the following token descriptions, only the additional data following the token identifier is described.

3.2 Operators

There are 3 types of operators:

- Unary operators like the minus sign that negates a value. These operators pop the topmost operand from the stack.
- Binary operators like addition or multiplication. These operators pop the two topmost operands from the stack.
- Function operators represent the sheet functions of Excel. They operate on different numbers of topmost operands on the stack. Either the function expects a fixed number of operands (for instance SIN expects one operand), or a variable number of operands given in the function token (for instance SUM is able to process 0 to 30 operands).

3.3 Token Classes

3.3.1 Classified Tokens

Function operators and operand tokens exist in 3 different versions: reference class tokens, value class tokens and array class tokens. The token class depends on which type of data the involved operator expects. Sometimes only 1 or 2 token classes are valid for a token.

- Reference class token: The reference itself, independent of the cell contents.
- Value class token: A dereferenced value.
- Array class token: A matrix array of values (fixed values or a cell range).

The structure of the 8-bit operand token identifier is described in the following table.

Bit	Mask	Contents
4-0	1F _H	Basic token identifier
6-5	60 _H	01 ₂ = Reference class token (token range 20 _H -3F _H) 10 ₂ = Value class token (token range 40 _H -5F _H) 11 ₂ = Array class token (token range 60 _H -7F _H)
7	80 _H	0 ₂ (zero)

The token class is marked in the names of the tokens. The names of reference class tokens contain a trailing “R”, value class tokens contain a trailing “V” and the names of array class tokens a trailing “A”.

3.3.2 Operand Classes

Each operand has a default token class, called operand class. The return values of operators and functions are treated as operand class, too.

Examples for operand classes:

- Reference class:
A1, B2 : C3 (cell and cell range references, tRefR and tAreaR);
INDEX (A1, 1, 1) (return value of the INDEX function, tFuncVarR);
A1 A1 (return value of the intersection operator, tIsect).
- Value class:
SUM (2, 3) (return value of the SUM function, tFuncVarV);
2+3 (return value of addition operator, tAdd).
- Array class:
{2, 3} (constant array, tArrayA);
TRANSPOSE ({2, 3}) (return value of the TRANSPOSE function, tFuncA).

3.3.3 Expected Parameter Classes

Function parameters expect operands of specific operand classes. The expected token classes of all function parameters are specified in the list of built-in functions (→3.12). The result of the whole formula is handled as a parameter, called the root level parameter (of the equality sign). The root level also expects a specific token class.

Examples for function parameter classes:

- Reference class:
ROW(A1) (the function ROW expects references, ROW(1) would produce an error).
- Value class:
ABS(A1) (the function ABS expects values, it dereferences the cell reference to a value).
- Array class:
MDETERM(A1:C3) (the function MDETERM expects arrays, it dereferences the cell range to an array of values).
- Root level:
=A1 (parameter is on formula root level).

The function SUM is an exception in this case: It expects reference class tokens, but can handle with value class and array class tokens too. The following example shows the differences in the handling of references in array formulas.

Example for different reference class token handling. The area tokens in column B and C all have reference class. Column D illustrates the difference between SUM and the addition operator.

A sheet range with the entered array formulas:

	A	B	C	D	E
1	4	{=ROW(A1:A2)}	{=SUM(A1:A2,0)}	{=A1:A2+0}	
2	5	{=ROW(A1:A2)}	{=SUM(A1:A2,0)}	{=A1:A2+0}	

The results:

	A	B	C	D	E
1	4	1	9	4	
2	5	2	9	5	

3.3.4 Token Class Transformation

The final class of a token depends on the combination of the operand class of the token and the expected parameter class. Furthermore it is dependent on the type of the formula. There are 3 different types of formulas:

Formula type	Examples
Cell formula type	Cell formulas, Shared formulas (→4.4)
Array formula type	Array formulas (→4.4), Conditional Formatting (→4.6), Data Validation (→4.7)
Name formula type	Defined names

The following tables show the rules of how to find the correct token class. Each table describes the behavior of a token for a specific parameter type (currently tested in BIFF8 only).

- Current position is a function parameter expecting a *reference class token*. Note: Only SUM is able to handle value and array class tokens. Other functions will produce an error. The operand of the function (for instance ROW/SUM) will change from/to:

Operand class	Example formula	Token def. name	Cell formulas	Array formulas	Name formulas
R	=ROW(A1)	tRefR	R	R	R
V	=SUM(PI())	tFuncV	V	A	A
A	=SUM({1})	tArrayA	A	A	A

- Current position is a function parameter expecting a *value class token*. The operand of the function (for instance ABS) will change from/to:

Operand class	Example formula	Token def. name	Cell formulas	Array formulas	Name formulas
R	=ABS(A1)	tRefR	V	V	A
V	=ABS(PI())	tFuncV	V	V	A
A	=ABS({1})	tArrayA	V	V	A

- Current position is a function parameter expecting an *array class token*. The operand of the function (for instance MDETERM) will change from/to:

Operand class	Example formula	Token def. name	Cell formulas	Array formulas	Name formulas
R	=MDETERM(A1)	tRefR	A	A	A
V	=MDETERM(PI())	tFuncV	V	A	A
A	=MDETERM({1})	tArrayA	A	A	A

- Current position is the *root level* of the formula. The operand will change from/to:

Operand class	Example formula	Token def. name	Cell formulas	Array formulas	Name formulas
R	=A1	tRefR	V	V	R
V	=PI()	tFuncV	V	V	A
A	tArrayA	V	V	A	

Example: The formula =ABS(A1) contains the reference A1 (default token is tRefR). The function ABS expects a value class parameter. The first line of the second table shows that tRefR will be changed to tRefA in defined names and to tRefV in all other types of formulas. The operand class of the ABS function itself (token class of the return value) is value class (tFuncV). The function is on root level. The second line of the last table shows how it will be modified. This token keeps unchanged in all formulas except defined names where it changes to tFuncA.

The resulting token array of this formula would be
in a cell: tRefV(A1), tFuncV(ABS);
in a defined name: tRefA(A1), tFuncA(ABS).

Unary and binary operators (for instance tAdd, tPower, tEQ, tUminus) do not change the token class of their operand(s) themselves. Furthermore they pass a requested change of the own token class to their operand(s). This is done recursively, if the operand is an unary or binary operator again. The reference operators (tIsect, tUnion and tRange) are always encapsulated into reference subexpression tokens (for instance tMemArea, →3.10.5, or tMemFunc, →3.10.6). These tokens will change their token class. The operands of the reference operators will not be changed.

Example: The formula =SUM(A1 A1, A2+A3) (entered as array formula) expects reference class for both parameters. All cell reference tokens still have reference class (the operators did not change it). The intersection operator tIsect and its operands are encapsulated into a tMemAreaR token. This token keeps unchanged (first line in first table). The addition operator tAdd has value operand class. The second line of the first table shows that this token class will be changed to array class (in an array formula). The operator passes this change to its operands. The function SUM has value operand class which will keep unchanged on root level (see last table).

The resulting token array of this array formula is:
tMemAreaR(3 tokens), tRefR(A1), tRefR(A1), tIsect, tRefA(A2), tRefA(A3), tAdd, tFuncVarV(SUM).

3.4 Encoding of Cell References in Tokens

3.4.1 Cell References in BIFF2-BIFF7

In the BIFF versions up to BIFF7, it is possible to use 16384 (2^{14}) rows. A cell reference contains the row index as a 16-bit-value (zero-based, 0-16383), the column index as an 8-bit-value (zero-based, 0-255) and two flags. The flags specify whether the row or column index is absolute or relative.

Contents of the row index (16-bit-value), BIFF2-BIFF7:

Bit	Mask	Contents	
13-0	3FFF _H	Index to row (0-16383)	
14	4000 _H	0 = Absolute column reference	1 = Relative column reference
15	8000 _H	0 = Absolute row reference	1 = Relative row reference

Example: The reference B\$6 has the absolute row index 5 and the relative column index 1. The value of the encoded row index is 4005_H (row 6, column is relative). The value of the column index is 01_H (column B).

3.4.2 Cell References in BIFF8

From BIFF8 on 65536 (2^{16}) rows are available. Therefore the column index field expands to a 16-bit-value and contains the relative flags.

Contents of the column index (16-bit-value), BIFF8:

Bit	Mask	Contents	
7-0	00FF _H	Index to column (0-255)	
14	4000 _H	0 = Absolute column reference	1 = Relative column reference
15	8000 _H	0 = Absolute row reference	1 = Relative row reference

Example: The reference B\$6 has the absolute row index 5 and the relative column index 1. The value of the encoded column index is 4001_H (column B, column is relative). The value of the row index is 0005_H (row 6).

3.5 Token Overview

Following a list of all tokens, separated into the several token types and ordered by token identifier.

3.5.1 Unary Operator Tokens

Token ID	Token name	Description
12 _H	tUpplus	Unary plus
13 _H	tUminus	Unary minus
14 _H	tPercent	Percent sign
15 _H	tParen	Parentheses

3.5.2 Binary Operator Tokens

Token ID	Token name	Description
03 _H	tAdd	Addition
04 _H	tSub	Subtraction
05 _H	tMul	Multiplication
06 _H	tDiv	Division
07 _H	tPower	Exponentiation
08 _H	tConcat	Concatenation
09 _H	tLT	Less than
0A _H	tLE	Less than or equal
0B _H	tEQ	Equal
0C _H	tGE	Greater than or equal
0D _H	tGT	Greater than
0E _H	tNE	Not equal
0F _H	tIsect	Cell range intersection
10 _H	tUnion	Cell range union
11 _H	tRange	Cell range

3.5.3 Function Operator Tokens

Token ID	Token name	Description
21 _H 41 _H 61 _H	tFunc	Function with fixed number of arguments
22 _H 42 _H 62 _H	tFuncVar	Function with variable number of arguments

3.5.4 Constant Operand Tokens

Token ID	Token name	Description
16 _H	tMissArg	Missing argument
17 _H	pgStr	String constant
1C _H	tErr	Error value
1D _H	tBool	Boolean value
1E _H	tInt	Integer value
1F _H	tNum	Floating-point number

3.5.5 Operand Tokens

Token ID	Token name	Description
20 _H 40 _H 60 _H	tArray	Array constant
23 _H 43 _H 63 _H	tName	Internal defined name
24 _H 44 _H 64 _H	tRef	2D cell reference
25 _H 45 _H 65 _H	tArea	2D area reference
26 _H 46 _H 66 _H	tMemArea	
29 _H 49 _H 69 _H	tMemFunc	
2A _H 4A _H 6A _H	tRefErr	Deleted 2D cell reference
2B _H 4B _H 6B _H	tAreaErr	Deleted 2D area reference
2C _H 4C _H 6C _H	tRefN	
2D _H 4D _H 6D _H	tAreaN	
39 _H 59 _H 79 _H	tNameX	External name
3A _H 5A _H 7A _H	tRef3d	3D cell reference
3B _H 5B _H 7B _H	tArea3d	3D area reference
3C _H 5C _H 7C _H	tRefErr3d	Deleted 3D cell reference
3D _H 5D _H 7D _H	tAreaErr3d	Deleted 3D area reference

3.5.6 Control Tokens

Token ID	Token name	Description
01 _H	tExp	
02 _H	tTbl	
18 _H	tNatFmla	
19 _H	tAttr	
1A _H	tSheet	
1B _H	tEndSheet	

3.5.7 Overview, Ordered by Token IDs

ID	Token name	ID	Token name
00 _H	Not used	20 _H	tArray
01 _H	tExp	21 _H	tFunc
02 _H	tTbl	22 _H	tFuncVar
03 _H	tAdd	23 _H	tName
04 _H	tSub	24 _H	tRef
05 _H	tMul	25 _H	tArea
06 _H	tDiv	26 _H	tMemArea
07 _H	tPower	27 _H	tMemErr
08 _H	tConcat	28 _H	tMemNoMem
09 _H	tLT	29 _H	tMemFunc
0A _H	tLE	2A _H	tRefErr
0B _H	tEQ	2B _H	tAreaErr
0C _H	tGE	2C _H	tRefN
0D _H	tGT	2D _H	tAreaN
0E _H	tNE	2E _H	tMemAreaN
0F _H	tIsect	2F _H	tMemNoMemN
10 _H	tUnion	30 _H	70 _H
11 _H	tRange	31 _H	71 _H
12 _H	tUplus	32 _H	72 _H
13 _H	tUminus	33 _H	73 _H
14 _H	tPercent	34 _H	74 _H
15 _H	tParen	35 _H	75 _H
16 _H	tMissArg	36 _H	76 _H
17 _H	tStr	37 _H	77 _H
18 _H	tNatFmla	38 _H	78 _H
19 _H	tAttr	39 _H	tNameX
1A _H	tSheet	3A _H	5A _H
1B _H	tEndSheet	3B _H	5B _H
1C _H	tErr	3C _H	5C _H
1D _H	tBool	3D _H	5D _H
1E _H	tInt	3E _H	5E _H
1F _H	tNum	3F _H	5F _H

3.6 Unary Operator Tokens

Unary operators perform an operation with the topmost operand from stack. The tokens do not contain any additional data.

3.6.1 tUplus (12_H)

Unary plus operator. This operator has no effect on the operand. Parameter class: V.

Example: +A1 returns the value of cell A1.

3.6.2 tUminus (13_H)

Unary minus operator. Negates the operand. Parameter class: V.

Example: -1 returns the negated value of cell A1.

3.6.3 tPercent (14_H)

Percent sign. Divides the operand by 100. Parameter class: V.

Example: 1% returns 0.01.

3.6.4 tParen (15_H)

Parentheses. This token is for display purposes only, it does not affect the result of the token array. If it follows an operator, the parentheses will enclose the operator and its operand(s). This operator does not modify the token class of its operand.

Examples: Enclosing an operand: 3+ (2) , - (A1) ; enclosing an operator: (3+2) , (-A1) .

3.7 Binary Operator Tokens

Binary operators perform an operation with the two topmost operands from stack. The tokens do not contain any additional data.

3.7.1 tAdd (03_H)

Addition operator. Adds the operands. Parameter class: V.

Example: 3+2 returns 5.

3.7.2 tSub (04_H)

Subtraction operator. Subtracts the top operand from the second-to-top operand. Parameter class: V.

Example: 3-2 returns 1.

3.7.3 tMul (05_H)

Multiplication operator. Multiplicates the operands. Parameter class: V.

Example: $3 * 2$ returns 6.

3.7.4 tDiv (06_H)

Division operator. Divides the second-to-top operand by the top operand. Parameter class: V.

Example: $3 / 2$ returns 1.5.

3.7.5 tPower (07_H)

Exponentiation operator. Raises the second-to-top operand to the power of the top operand. Parameter class: V.

Example: $3 ^ 2$ returns 9.

3.7.6 tConcat (08_H)

Concatenation operator. Appends the top operand to the second-to-top operand. Parameter class: V.

Example: "ABC" & "DEF" returns "ABCDEF".

3.7.7 tLT (09_H)

Less than operator. Returns TRUE if the second-to-top operand is less than the top operand. Parameter class: V.

Example: $3 < 2$ returns FALSE.

3.7.8 tLE (0A_H)

Less than or equal operator. Returns TRUE if the second-to-top operand is less than or equal to the top operand. Parameter class: V.

Example: $3 \leq 2$ returns FALSE.

3.7.9 tEQ (0B_H)

Equality operator. Returns TRUE if the operands are equal. Parameter class: V.

Example: $3 = 2$ returns FALSE.

3.7.10 tGE (0C_H)

Greater than or equal operator. Returns TRUE if the second-to-top operand is greater than or equal to the top operand. Parameter class: V.

Example: $3 \geq 2$ returns TRUE.

3.7.11 tGT (0D_H)

Greater than operator. Returns TRUE if the second-to-top operand is greater than the top operand. Parameter class: V.

Example: $3 > 2$ returns TRUE.

3.7.12 tNE (0E_H)

Inequality operator. Returns TRUE if the operands are not equal. Parameter class: V.

Example: 3<>2 returns TRUE.

3.7.13 tIsect (0F_H)

Intersection operator, represented by the space sign. Returns the intersected range of two ranges. Parameter class: R.

Example: A1:B3 B2:C3 returns B2:B3. If the resulting cell range is empty, the formula will return the error code #NULL! (for instance A1:A2 B3).

3.7.14 tUnion (10_H)

Union operator, represented by the comma sign (for instance English Excel) or semicolon (for instance German Excel). Returns the union of two ranges. Parameter class: R.

Example: (A1:A2,A4) will be handled as one operand (useful for function parameters).

3.7.15 tRange (11_H)

Range operator, represented by the colon sign. Returns the rectangular range formed by two ranges. This token occurs for instance by using defined names. Parameter class: R.

Example: namedcell1:D5. If the resulting cell range is empty, the formula will return the error code #NULL!.

3.8 Function Operator Tokens

The reference class of function operator tokens depend on the function itself and on the position of the function inside of the formula (for instance the expected class for the current parameter of an enclosing function).

3.8.1 tFunc (21_H, 41_H, 61_H)

This token contains the index to a built-in function with fixed number of arguments. The return operand class is dependent on the function.

Token tFunc, BIFF2-BIFF3:

Offset	Size	Contents
0	1	Index to a built-in sheet function (→3.12)

Token tFunc, BIFF4-BIFF8:

Offset	Size	Contents
0	2	Index to a built-in sheet function (→3.12)

3.8.2 tFuncVar (22_H, 42_H, 62_H)

This token contains the index to a built-in function with variable number of arguments. The return operand class is dependent on the function.

Token tFuncVar, BIFF2-BIFF3:

Offset	Size	Contents
0	1	Number of arguments
1	1	Index to a built-in sheet function (→3.12)

Token tFuncVar, BIFF4-BIFF8:

Offset	Size	Contents
0	1	Number of arguments
1	2	Index to a built-in sheet function (→3.12)

3.9 Constant Operand Tokens

3.9.1 tMissArg (16_H)

A missing argument in a function argument list is stored as a tMissArg token. This token does not contain any additional data.

Example: SUM(1, ,3) – second argument is missing and represented by a tMissArg token.

3.9.2 tStr (17_H)

This token contains a string constant. The maximum length of the string is 253 characters in BIFF2 (due to the limitation of 255 bytes per formula) and 255 characters in BIFF3-BIFF7.

Token tStr, BIFF2-BIFF7:

Offset	Size	Contents
0	var.	Byte string, 8-bit string length (→2.1)

Token tStr, BIFF8:

Offset	Size	Contents
0	var.	Unicode string, 16-bit string length, option flags occur always (→2.2)

Example: "ABC".

3.9.3 tErr (1C_H)

This token contains an error code.

Offset	Size	Contents
0	1	Error code (→2.4)

3.9.4 tBool (1D_H)

This token contains a Boolean value (TRUE or FALSE).

Offset	Size	Contents
0	1	0 = FALSE, 1 = TRUE

3.9.5 tInt (1E_H)

This token contains an unsigned 16-bit-integer value in the range from 0 to 65535.

Offset	Size	Contents
0	2	Unsigned integer value

3.9.6 tNumber (1F_H)

This token contains an IEEE floating-point number.

Offset	Size	Contents
0	8	IEEE floating-point number

3.10 Operand Tokens

3.10.1 tArray (20_H, 40_H, 60_H)

This token contains an array constant. For instance the 2x1 matrix { 1 ; 2 } is an array constant. The values of the array constant do not follow the token identifier but are stored behind the complete token array. Default class: tArrayA.

Token tArray, BIFF2-BIFF8:

Offset	Size	Contents
0	7	Not used

The constants of the array are stored row by row behind the formula in a list. The length of this list does *not* count into the leading formula size field.

Array constant list, BIFF2-BIFF7:

Offset	Size	Contents
0	1	Number of columns (<u>nc</u>). The value 0 means 256 columns.
1	2	Number of rows (<u>nr</u>)
3	var.	List of <u>nc</u> : <u>nr</u> cached values (→2.5)

Array constant list, BIFF8:

Offset	Size	Contents
0	1	Number of columns decreased by 1 (<u>nc</u>)
1	2	Number of rows decreased by 1 (<u>nr</u>)
3	var.	List of (<u>nc</u> +1)·(<u>nr</u> +1) cached values (→2.5)

3.10.2 tName (23_H, 43_H, 63_H)

This token contains the *one-based* index to a NAME record (→5.39). In BIFF2-BIFF4 this could be the index to an EXTERNNAME record (→5.23) too. From BIFF5 on an external name is represented by the token tNameX (→3.10.11). Default class: tNameR.

Token tName, BIFF2:

Offset	Size	Contents
0	2	<i>One-based</i> index to NAME record (→5.39) or EXTERNNAME record (→5.23)
2	5	Not used

Token tName, BIFF3-BIFF4:

Offset	Size	Contents
0	2	<i>One-based</i> index to NAME record (→5.39) or EXTERNNAME record (→5.23)
2	8	Not used

Token tName, BIFF5/BIFF7:

Offset	Size	Contents
0	2	<i>One-based</i> index to NAME record (→5.39)
2	12	Not used

Token tName, BIFF8:

Offset	Size	Contents
0	2	<i>One-based</i> index to NAME record (→5.39)
2	2	Not used

3.10.3 tRef (24_H, 44_H, 64_H)

This token contains the reference to a cell in the same sheet. Default class: tRefR.

Token tRef, BIFF2-BIFF7:

Offset	Size	Contents
0	2	Index to row and relative flags (→3.4.1)
2	1	Index to column

Token tRef, BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column and relative flags (→3.4.2)

3.10.4 tArea (25_H, 45_H, 65_H)

This token contains the reference to a rectangular cell range in the same sheet. Default class: tAreaR.

Token tArea, BIFF2-BIFF7:

Offset	Size	Contents
0	2	Index to first row and relative flags (→3.4.1)
2	2	Index to last row and relative flags (→3.4.1)
4	1	Index to first column
5	1	Index to last column

Token tArea, BIFF8:

Offset	Size	Contents
0	2	Index to first row
2	2	Index to last row
4	2	Index to first column and relative flags (→3.4.2)
6	2	Index to last column and relative flags (→3.4.2)

3.10.5 tMemArea (26_H, 46_H, 66_H)

2do

Default class: tMemAreaR.

3.10.6 tMemFunc (29_H, 49_H, 69_H)

2do

Default class: tMemFuncR.

3.10.7 tRefErr (2A_H, 4A_H, 6A_H)

This token contains the last reference to a deleted cell in the same sheet. The structure is equal to the token tRef (→3.10.3). Default class: tRefErrR.

3.10.8 tAreaErr (2B_H, 4B_H, 6B_H)

This token contains the last reference to a deleted rectangular cell range in the same sheet. The structure is equal to the token tArea (→3.10.4). Default class: tAreaErrR.

3.10.9 tRefN (2C_H, 4C_H, 6C_H)

2do

Default class: tRefNR.

3.10.10 tAreaN (2D_H, 4D_H, 6D_H)

2do

Default class: tAreaNR.

3.10.11 tNameX (39_H, 59_H, 79_H) (BIFF5-BIFF8)

This token contains the index to a NAME or EXTERNNAME record. It occurs by using internal or external names, AddIn functions, DDE links or linked OLE objects. See →4.3.2 for details about references in BIFF5/BIFF7 and →4.3.3 for BIFF8. Default class: tNameXR.

Token tNameX, BIFF5/BIFF7:

Offset	Size	Contents
0	2	<i>One-based</i> index to EXTERNSHEET record (→5.24). A negative value indicates the own workbook. In this case a NAME record is indexed below. The absolute value is the (<i>one-based</i>) index of the EXTERNSHEET record that contains the sheet name.
2	8	Not used
10	2	<i>One-based</i> index to NAME record (→5.39) or EXTERNNAME record (→5.23)
12	12	Not used

Token tNameX, BIFF8:

Offset	Size	Contents
0	2	Index to REF entry in EXTERNSHEET record (→5.24)
2	2	<i>One-based</i> index to NAME record (→5.39) or EXTERNNAME record (→5.23)
4	2	Not used

3.10.12 tRef3d (3A_H, 5A_H, 7A_H) (BIFF5-BIFF8)

This token contains a 3D reference or an external reference to a cell. See →4.3.2 for details about references in BIFF5/BIFF7 and →4.3.3 for BIFF8. Default class: tRef3dR.

Token tRef3d, BIFF5/BIFF7:

Offset	Size	Contents
0	2	<i>One-based</i> index to EXTERNSHEET record (→5.24). A negative value indicates a 3D reference to the own workbook. The absolute value is the (<i>one-based</i>) index of the EXTERNSHEET record that contains the first sheet name.
2	8	Not used
10	2	3D reference: Index of first referenced sheet; External reference: Not used
12	2	3D reference: Index of last referenced sheet; External reference: Not used
14	2	Index to row and relative flags (→3.4.1)
16	1	Index to column

Token tRef3d, BIFF8:

Offset	Size	Contents
0	2	Index to REF entry in EXTERNSHEET record (→5.24)
2	2	Index to row
4	2	Index to column and relative flags (→3.4.2)

3.10.13 tArea3d (3B_H, 5B_H, 7B_H) (BIFF5-BIFF8)

This token contains a 3D reference or an external reference to a rectangular cell range. See →4.3.2 for details about references in BIFF5/BIFF7 and →4.3.3 for BIFF8. Default class: tArea3dR.

Token tArea3d, BIFF5/BIFF7:

Offset	Size	Contents
0	2	<i>One-based</i> index to EXTERNSHEET record (→5.24). A negative value indicates a 3D reference to the own workbook. The absolute value is the (<i>one-based</i>) index of the EXTERNSHEET record that contains the first sheet name.
2	8	Not used
10	2	3D reference: Index of first referenced sheet; External reference: Not used
12	2	3D reference: Index of last referenced sheet; External reference: Not used
14	2	Index to first row and relative flags (→3.4.1)
16	2	Index to last row and relative flags (→3.4.1)
18	1	Index to first column
19	1	Index to last column

Token tArea3d, BIFF8:

Offset	Size	Contents
0	2	Index to REF entry in EXTERNSHEET record (→5.24)
2	2	Index to first row
4	2	Index to last row
6	2	Index to first column and relative flags (→3.4.2)
8	2	Index to last column and relative flags (→3.4.2)

3.10.14 tRefErr3d (3C_H, 5C_H, 7C_H) (BIFF5-BIFF8)

This token contains the last 3D reference or external reference to a deleted cell. The structure is equal to the token tRef3d (→3.10.12). Default class: tRefErr3dR.

3.10.15 tAreaErr3d (3D_H, 5D_H, 7D_H) (BIFF5-BIFF8)

This token contains the last 3D reference or external reference to a deleted rectangular cell range. The structure is equal to the token tArea3d (→3.10.13). Default class: tAreaErr3dR.

3.11 Control Tokens

2do

3.12 Built-in Sheet Functions

2do

4 Worksheet/Workbook Structure

In an Excel file, the complex contents are split into several records. To keep the stream consistent, the position and order of the records is very important. This chapter contains details about the correct combination of the records inside of the stream. The internal structure of the records is described in chapter 5.

4.1 The Worksheet/Workbook Stream

4.1.1 Worksheet Stream (BIFF2-BIFF4)

The whole worksheet file consists of the worksheet stream. All records of the worksheet are enclosed by a leading BOF record (→5.5) and a trailing EOF record (→5.21). The sheet contents area contains all information about the worksheet, for instance sheet dimension, view settings, a font list, a list of defined names and external references, of course the contents and formats of all cells, row heights, column widths, drawing objects, chart objects, etc.

Common structure of a worksheet stream:

BOF	Type = worksheet
	Sheet records
EOF	

4.1.2 Workbook Stream (BIFF4)

The whole BIFF4 workbook file consists of the workbook stream. It contains the global workbook data and a list of worksheets. The workbook globals contain common information about the workbook, for instance text encoding, global view settings or a list of all sheet names. Additionally, in each workbook a SHEETSOFFSET record (→5.53) is present. The data of the sheets is stored in worksheet substreams, which are embedded in the workbook globals. Each substream is preceded by a SHEETHDR record (→5.50) which contains the name of the sheet and the size of the following substream. The SHEETSOFFSET record mentioned above contains the stream position of the first SHEETHDR record. The substreams have the same structure as described in chapter 4.1.1. Note: In this context the term “substream” is only a sequence of records and not a storage sub stream of OLE2 storages.

Common structure of a workbook stream with two sheets, BIFF4:

BOF	Type = workbook globals
	Workbook globals
SHEETSOFFSET	Position of the first SHEETHDR record
	Workbook globals
SHEETHDR	Sheet name = "Sheet1", Byte length of following BOF/EOF record block
BOF	Type = worksheet
	Sheet records
EOF	
SHEETHDR	Sheet name = "Sheet2", Byte length of following BOF/EOF record block
BOF	Type = worksheet
	Sheet records
EOF	
EOF	

4.1.3 Workbook Stream (BIFF5-BIFF8)

From BIFF5 on an Excel document is stored as an OLE2 storage. The workbook stream is located in the root directory of the storage. In BIFF5/BIFF7 it is named "Book", in BIFF8 "Workbook" (case sensitive). In difference to the BIFF4 workbook stream, the worksheet substreams are appended to the workbook globals substream, not embedded. The workbook globals and sheet substreams have similar contents as described for BIFF4 workbooks (→4.1.2).

Common structure of a workbook stream with two sheets, BIFF5-BIFF8:

BOF	Type = workbook globals
	Workbook globals
EOF	
BOF	Type = worksheet
	Sheet records
EOF	
BOF	Type = worksheet
	Sheet records
EOF	

4.1.4 Structure of the Workbook Globals Substream

Records in the workbook globals substream can be divided into several types.

- Workbook settings: Options and other settings for the workbook (for instance view settings, protection)
- Workbook contents: Contents used elsewhere in the workbook (for instance format definitions, defined names)

Detailed structure of the workbook globals substream:

BOF	Type = worksheet
	Workbook settings
	Workbook contents
EOF	

4.1.5 Structure of the Worksheet Substream

Records in a worksheet substream can be divided into several types.

- Sheet settings: Options and other settings for the current sheet (for instance view settings, page settings)
- Cell records: All cell contents (values, formulas, etc.), merged with row and column settings
- Sheet contents: More contents of the sheet, regarding several cells (for instance cell merging, Data Validation)

Detailed structure of the worksheet substream:

BOF	Type = worksheet
	Sheet settings
	Cell records
	Sheet contents
EOF	

4.2 Shared String Table (BIFF8)

A BIFF8 workbook collects all strings of all text cells in a global list, the shared string table (SST). This table is located in the equal-named record SST (→5.54) in the workbook contents area of the workbook globals substream (→4.1.4). An SST record is followed by an EXTSST record (→5.25) which stores stream positions for a string hash table. Text cells are represented by LABELSST records (→5.35) which contain indexes to the shared string table. For reading Excel files only the SST record and the LABELSST records are important.

Example: A workbook contains anywhere the strings “AAA”, “BBB” and “CCC”.

BOF	Type = workbook globals
	Workbook globals
SST	String 0 = “AAA” String 1 = “BBB” String 2 = “CCC”
EXTSST	
	Workbook globals
EOF	
BOF	Type = worksheet
	Cell records
LABELSST	String = 0
LABELSST	String = 2
	Cell records
LABELSST	String = 1
LABELSST	String = 0
	Cell records
EOF	

4.3 Internal and External References

This chapter describes all types of 3D and external references. In detail, this could be:

- a reference to a cell or a cell range of another sheet in the same workbook (3D reference),
- a reference to a cell or a cell range of a sheet in another workbook (external reference),
- a reference to a global or local defined name (internal name),
- a reference to a defined name in another workbook (external name),
- an AddIn function,
- a DDE link,
- an OLE object link.

For external references and external names a combination of XCT and CRN records occurs which store values of cells of the document. In the case the document cannot be found these values will be used to get the result of an external reference. An XCT record (→5.58) contains the number of following CRN records. A CRN record (→5.15) stores the contents of one cell or a sequence of cells of one row. Fragmentary cell ranges or cell ranges spanning over more than one row are split into several CRN records. 3D references do not use these records because the referenced cells are located in the own document.

From BIFF5 on the optional record BOOKBOOL (→5.6) determines whether the cached values (the XCT and CRN records) will be stored in the file.

4.3.1 References in BIFF2-BIFF4

2do

4.3.2 References in BIFF5/BIFF7

The document names and sheet names of references are stored in a list of EXTERNSHEET records. Each worksheet contains an EXTERNSHEET with documents referenced from this sheet. Formulas in the sheet use indexes to this local EXTERNSHEET list. All example record listings are located in the sheet settings area of the respective worksheet substream (→4.1.5).

The XCT and CRN records occur behind the last EXTERNNAME record as far as they exist, otherwise directly behind the respective EXTERNSHEET record.

- **External and 3D references**

External and 3D references are represented in a formula by the tokens tRef3d (→3.10.12) or tArea3d (→3.10.13). These tokens contain an index to an EXTERNSHEET record located in the own worksheet and indexes to the first and last referenced sheet.

For 3D references, the tokens contain a negative EXTERNSHEET index, indicating a reference into the own workbook. The absolute value is the *one-based* index of the EXTERNSHEET record that contains the name of the first sheet. If the referenced sheets do not exist anymore, these tokens contain the sheet indexes FFFF_H (deleted 3D reference).

Each external reference contains the *one-based* index to an EXTERNSHEET record. The sheet indexes of the tokens are not used.

Example: A document with 7 sheets (named from “Sheet1” to “Sheet7”) contains on “Sheet1” the formulas
=Sheet2!A1,
=SUM(Sheet4:Sheet6!A1:B3),
=SUM([example.xls]ExtSheet1!A1:B2) (contents: A1=1.11, B1=2.22, A2=3.33, B2=4.44),
=[example.xls]ExtSheet3!A1 (contents: “ABCD”) and
=Sheet8!A1.

EXTERNSHEET 1	Name = “Sheet2”
EXTERNSHEET 2	Name = “Sheet4”
EXTERNSHEET 3	Name = “Sheet6”
EXTERNSHEET 4	Name = “[example.xls]ExtSheet1”
XCT	Number of CRN = 2
CRN 0	Cell range = A1:B1, contents = 1.11, 2.22
CRN 1	Cell range = A2:B2, contents = 3.33, 4.44
EXTERNSHEET 5	Name = “[example.xls]ExtSheet3”
XCT	Number of CRN = 1
CRN 0	Cell range = A1, contents = “ABCD”
EXTERNSHEET 6	Name = “Sheet8”

- **Internal names**

2do

- **External names**

2do

- **AddIn functions**

2do

- DDE links, OLE object links

2do

4.3.3 References in BIFF8

The main data of all types of references is stored in a list inside of the workbook globals section. All formulas use only indexes to use specific references. In BIFF8 each referenced document is represented by a SUPBOOK record (→5.56). A SUPBOOK contains the name of the document and the names of the sheets of the document. After the last SUPBOOK occurs only one EXTERNSHEET record (→5.24). It contains a list with indexes to the SUPBOOKs for each used reference anywhere in the document. Formulas use indexes into this EXTERNSHEET list.

For the following examples an external document “example.xls” is used. It contains 3 sheets named “ExtSheet1”, “ExtSheet2” and “ExtSheet3”.

Example: A document contains (among other references) the two formulas

```
= [example.xls]ExtSheet2!A1 and  
= [example.xls]ExtSheet1!A1.
```

Workbook globals	
SUPBOOK 0	Any content
SUPBOOK 1	Document = “example.xls” Sheet 0 = “ExtSheet1” Sheet 1 = “ExtSheet2” Sheet 2 = “ExtSheet3”
SUPBOOK 2	Any content
EXTERNSHEET	REF 0 = any reference REF 1 = {SUPBOOK = 1, sheet range = 1...1} REF 2 = any reference REF 3 = {SUPBOOK = 1, sheet range = 0...0} REF 4 = any reference
Workbook globals	

The first formula uses REF 1 in the EXTERNSHEET record. REF 1 refers to SUPBOOK 1 and sheet range 1...1. This means, the document “example.xls” is used (document of SUPBOOK 1) and the name of the sheet is “ExtSheet2” (sheet 1 of SUPBOOK 1). In the same way, the second formula uses REF 3 in the EXTERNSHEET record. All list entries inside of the EXTERNSHEET record are unique. For instance all formulas in the workbook referring to sheet “ExtSheet2” of the document “example.xls” use REF 1. All other SUPBOOKs and REFs are placeholders for other references in this example.

The XCT and CRN records occur behind the EXTERNNNAME records as far as they exist, otherwise directly behind the respective SUPBOOK record.

- External and 3D references

The SUPBOOK for the own document has a special format: It contains only the number of all sheets and the value 0401_H instead of the sheet names. The sheet range indexes in the EXTERNSHEET record refer to the position of the sheets (zero-based). If a referenced sheet does not exist anymore, the sheet index FFFF_H will occur (deleted 3D reference).

Example: A document with 7 sheets (named from “Sheet1” to “Sheet7”) contains the formulas

```
=Sheet2!A1,
=SUM(Sheet4:Sheet6!A1:B3),
=SUM([example.xls]ExtSheet1!A1:B2) (contents: A1=1.11, B1=2.22, A2=3.33, B2=4.44),
=[example.xls]ExtSheet3!A1 (contents: “ABCD”) and
=Sheet8!A1.
```

SUPBOOK 0	Number of sheets: 7 0401 _H (own workbook)
SUPBOOK 1	Document = “example.xls” Sheet 0 = “ExtSheet1” Sheet 1 = “ExtSheet2” Sheet 2 = “ExtSheet3”
XCT	Number of CRN = 2, sheet = 0 (ExtSheet1)
CRN 0	Cell range = A1:B1, contents = 1.11, 2.22
CRN 1	Cell range = A2:B2, contents = 3.33, 4.44
XCT	Number of CRN = 1, sheet = 2 (ExtSheet3)
CRN 0	Cell range = A1, contents = “ABCD”
EXTERNSSHEET	REF 0 = {SUPBOOK = 0, sheet range = 1...1} REF 1 = {SUPBOOK = 0, sheet range = 3...5} REF 2 = {SUPBOOK = 1, sheet range = 0...0} REF 3 = {SUPBOOK = 1, sheet range = 1...1} REF 4 = {SUPBOOK = 0, sheet range = FFFF _H ...FFFF _H }

Inside of the first formula the cell reference is represented by the token tRef3d (→3.10.12). The second formula contains the token tArea3d (→3.10.13).

• Internal names

All internal names are stored in a list of NAME records (→5.39) that follows the EXTERNSSHEET record. There exist two types of internal names: global names which are valid in the whole workbook and local names which are attached to a specific sheet. For instance the local name “MyCell” of the sheet “Sheet1” can be used from everywhere in the workbook by entering =Sheet1!MyCell. Each NAME record contains the name itself and an *one-based* sheet index. The index zero indicates a global name. If a SUPBOOK contains local names, a special REF entry will be created in the EXTERNSSHEET record. It contains the index to the SUPBOOK and the sheet range FFFE_H...FFFE_H.

Example for internal names: A document contains

- The global name “GlobalName”,
- The local names “Sheet1!Name” and “Sheet2!Name” and
- In Sheet1 the formulas =GlobalName, =Name, =Sheet1!Name and =Sheet2!Name.

SUPBOOK 0	Number of sheets: 3 0401 _H (own workbook)
EXTERNSSHEET	REF 0 = {SUPBOOK = 0, sheet range = 0...0} REF 1 = {SUPBOOK = 0, sheet range = FFFE _H ...FFFE _H }
NAME 1	Name = “GlobalName”, sheet = 0 (Global)
NAME 2	Name = “Name”, sheet = 1 (Sheet1)
NAME 3	Name = “Name”, sheet = 2 (Sheet2)

Inside of the formula a global name or a local name of the own sheet is represented by the token tName (→3.10.2) with an *one-based* index to the NAME record list. The first formula in the example above contains the token tNameV with index 1 and the second formula the same token with index 2.

Local names from other sheets are represented by the token tNameX (→3.10.11) with an index to the special REF entry of the EXTERNSSHEET record and an index to the NAME record list. The third formula contains the token tNameX with the value {REF = 1, Name = 2} and the last formula the same token with the value {REF = 1, Name = 3}. Ref 1 refers to SUPBOOK 0 and Name 2 or Name 3 refer to the respective NAME records.

- **External names**

In Excel formulas can use names located in another workbook. In this case for each name an EXTERNNNAME record (\rightarrow 5.23) after the SUPBOOK record occurs. The EXTERNNNAME record contains the name itself and the *one-based* index to the sheet. Again the index zero indicates a global name. If a SUPBOOK contains external names, a special REF entry will be created in the EXTERNSHEET record. It contains the index to the SUPBOOK and the sheet range FFFE_H...FFFE_H.

Example: A document contains the formulas

```
=example.xls!GlobalName (location: ExtSheet1!B22; contents: 22),
=[example.xls]ExtSheet3!Name (location: ExtSheet3!C33; contents: "ABCD") and
=[example.xls]ExtSheet1!Name (location: ExtSheet1!A11; contents: 11).
```

SUPBOOK 0	Document = "example.xls"
	Sheet 0 = "ExtSheet1"
	Sheet 1 = "ExtSheet2"
	Sheet 2 = "ExtSheet3"
EXTERNNNAME 1	Name = "GlobalName", sheet = 0 (Global)
EXTERNNNAME 2	Name = "Name", sheet = 3 (ExtSheet3)
EXTERNNNAME 3	Name = "Name", sheet = 1 (ExtSheet1)
XCT	Number of CRN = 2, sheet = 0 (ExtSheet1)
CRN 0	Cell range = A11, contents = 11
CRN 1	Cell range = B22, contents = 22
XCT	Number of CRN = 1, sheet = 2 (ExtSheet3)
CRN 0	Cell range = C33, contents = "ABCD"
EXTERNSHEET	REF 1 = {SUPBOOK = 0, sheet range = FFFE _H ...FFFE _H }

Inside of a formula an external name is represented by the token tNameX (\rightarrow 3.10.11). It contains the index to the special REF entry inside of the EXTERNSHEET record and the index to a EXTERNNNAME record (*one-based*). The second formula in the example above contains the token tNameXV with the value {REF = 0, ExtName = 2}. REF 1 refers to SUPBOOK 0 and ExtName 2 refers to EXTERNNNAME 2 (of SUPBOOK 0).

- **AddIn functions**

AddIn functions are stored similar to external names. If a formula uses an AddIn function, a special SUPBOOK containing only the value 3A01_H will occur. Behind of this SUPBOOK the names of all used AddIn functions are listed, each inside of an EXTERNNNAME record. A special REF entry with the sheet range FFFE_H...FFFE_H will be inserted into the EXTERNSHEET reference list.

Example: A document contains the formulas =ISODD(1) and =ISEVEN(1).

SUPBOOK 0	3A01 _H (AddIn)
EXTERNNNAME 1	Name = "ISODD"
EXTERNNNAME 2	Name = "ISEVEN"
EXTERNSHEET	REF 0 = {SUPBOOK = 0, sheet range = FFFE _H ...FFFE _H }

- **DDE links, OLE object links**

DDE links and OLE object links expect the name of the server application (DDE) or the class name (OLE) and the name of a source document. These items are encoded in a SUPBOOK record. The SUPBOOK is followed by EXTERNNAME records with additional data of the links. An EXTERNNAME record for a DDE links contains the item (data source range) and an EXTERNNAME record for an OLE object link contains the identifier of the object data storage.

Example: A document contains a DDE link to the range “Sheet1.A1:B2” inside of the Calc document “example.sxc” and an OLE object link to the bitmap file “example.bmp”.

SUPBOOK 0	Server application = “soffice” Document = “example.sxc”
EXTERNNAME 1	Type = DDE link Item = “Sheet1.A1:B2”
SUPBOOK 1	Class name = “Package” Document = “example.bmp”
EXTERNNAME 1	Type = OLE object link Storage = 00012345 _H (storage name = “LNK00012345”)
EXTERNSHHEET	REF 0 = {SUPBOOK = 0, sheet range = FFFE _H ...FFFE _H } REF 1 = {SUPBOOK = 1, sheet range = FFFE _H ...FFFE _H }

Inside of a formula a DDE link is represented by the token tNameX (→3.10.11). An OLE object link contains a tNameX token inside of its OBJ record.

4.4 Array Formulas, Shared Formulas

2do

4.5 Multiple Operations (Table Operations)

2do

4.6 Conditional Formatting (BIFF8)

2do

4.7 Data Validation (BIFF8)

Data Validation settings are stored for each sheet in the sheet contents area of the worksheet substream (→4.1.5). A DVAL record (→5.20) introduces the list of DV records (→5.19). The DVAL record contains the number of DV records and each DV record contains settings for a Data Validation and the addresses of all affected cells.

Example: A workbook contains 2 different Data Validation settings in the first sheet.

	Cell records
	Sheet contents
DVAL	Number of DV records = 2
DV 0	Data Validation settings
DV 1	Data Validation settings
	Sheet contents

4.8 AutoFilter

2do

4.9 Scenarios

2do

4.10 Web Queries (BIFF8)

2do

4.11 Protection

4.11.1 Worksheet/Workbook Protection

Not all records regarding protection must occur in the stream. If a record is omitted, the corresponding item is not active (for instance: omitting the OBJECTPROTECT record leaves objects unprotected).

- Single worksheet protection (BIFF2-BIFF4)

2do

- Sheet protection in a workbook (BIFF4-BIFF8)

2do

- Workbook protection (BIFF4-BIFF8)

2do

4.11.2 File Protection

2do

4.11.3 Password Hash Calculation

In several records the hash value of a password is stored, used for later verification of an entered password. Following a pseudo-code algorithm to create such a hash value from a given byte-string password:

- 1) hash ← 0; char_index ← 0;
- 2) char ← character from password with index char_index (right-to-left, 0 is rightmost character);
- 3) char_index ← char_index + 1;
- 4) rotate left lower 15 bits of char by char_index bits;
- 5) hash ← hash XOR char;
- 6) IF not processed all characters : JUMP 2);
- 7) RETURN hash XOR [password character count] XOR 0xCE4B;

4.11.4 Encryption Key Calculation (BIFF2-BIFF7)

To encrypt and decrypt the record contents, a 16-bit key is used. This key is calculated from the password. The FILEPASS record (→4.11.3) stores the key and the hash value of the password. Following a pseudo-code algorithm to create the encryption key from a given byte-string password:

- 1) key ← 0; char_index ← 0; key_base ← 0x8000; key_final ← 0xFFFF;
- 2) char ← character from password with index char_index (right-to-left, 0 is rightmost character);
- 3) char ← char AND 0x7F; {use only the lower 7 bits of each character}
- 4) bit_index ← 0;
- 5) rotate left lower 16 bits of key_base by 1 bit;
- 6) IF least significant bit of key_base set : key_base ← key_base XOR 0x1020;
- 7) rotate left lower 16 bits of key_final by 1 bit;
- 8) IF least significant bit of key_final set : key_final ← key_final XOR 0x1020;
- 9) IF bit with index bit_index in char set : key ← key XOR key_base;
- 10) bit_index ← bit_index + 1;
- 11) IF bit_index < 8 : JUMP 5);
- 12) char_index ← char_index + 1;
- 13) IF not processed all characters : JUMP 2);
- 14) RETURN key XOR key_final;

5 Worksheet/Workbook Records

5.1 Overview, Ordered by Record IDs

Record ID	Record name	Occurs in BIFF versions						
		2	3	4	5	7	8	8X
0000 _H	DIMENSIONS	•						
0001 _H	BLANK	•						
0002 _H	INTEGER	•						
0003 _H	NUMBER	•						
0004 _H	LABEL	•						
0005 _H	BOOLERR	•						
0006 _H	FORMULA	•		•	•	•	•	
0007 _H	STRING	•						
0009 _H	BOF	•						
000A _H	EOF	•	•	•	•	•	•	•
000C _H	CALCCOUNT	•	•	•	•	•	•	•
000D _H	CALCMODE	•	•	•	•	•	•	•
0012 _H	PROTECT	•	•	•	•	•	•	•
0013 _H	PASSWORD	•	•	•	•	•	•	•
0016 _H	EXTERNCOUNT	•	•	•	•	•		
0017 _H	EXTERNSHHEET	•	•	•	•	•	•	•
0018 _H	NAME	•		•	•	•	•	•
0019 _H	WINDOWPROTECT	•	•	•	•	•	•	•
001D _H	SELECTION	•	•	•	•	•	•	•
001E _H	FORMAT	•	•					
0020 _H	COLUMNDEFAULT	•						
0023 _H	EXTERNNAME	•		•	•	•	•	•
0024 _H	COLWIDTH	•						
002F _H	FILEPASS	•	•	•	•	•	•	•
0031 _H	FONT	•		•	•	•	•	•
003C _H	CONTINUE	•	•	•	•	•	•	•
0040 _H	BACKUP	•	•	•	•	•	•	•
0043 _H	XF	•						
0044 _H	IXFE	•						
0051 _H	DCONREF	•	•	•	•	•	•	•
0055 _H	DEFCOLWIDTH	•	•	•	•	•	•	•
0059 _H	XCT	•	•	•	•	•	•	•
005A _H	CRN	•	•	•	•	•	•	•
0063 _H	OBJECTPROTECT	•	•	•	•	•	•	•
007D _H	COLINFO	•	•	•	•	•	•	•

Record ID	Record name	Occurs in BIFF versions						
		2	3	4	5	7	8	8X
0085 _H	BOUNDSHEET				●	●	●	●
008E _H	SHEETOFFSET				●			
008F _H	SHEETHDR			●				
0092 _H	PALETTE	●	●		●	●	●	●
00BD _H	MULRK				●	●	●	●
00BE _H	MULBLANK				●	●	●	●
00DA _H	BOOKBOOL				●	●	●	●
00DD _H	SCENPROTECT				●	●	●	●
00E0 _H	XF				●	●	●	●
00E5 _H	MERGEDCELLS						●	●
00FC _H	SST						●	●
00FD _H	LABELSST						●	●
00FF _H	EXTSST						●	●
015F _H	LABELRANGES						●	●
01AE _H	SUPBOOK						●	●
01B2 _H	DVAL						●	●
01B8 _H	HLINK						●	●
01BE _H	DV						●	●
0200 _H	DIMENSIONS	●	●		●	●	●	●
0201 _H	BLANK	●	●		●	●	●	●
0203 _H	NUMBER	●	●		●	●	●	●
0204 _H	LABEL	●	●		●	●		
0205 _H	BOOLERR	●	●		●	●	●	●
0206 _H	FORMULA	●						
0207 _H	STRING	●	●		●	●	●	●
0209 _H	BOF	●						
0218 _H	NAME	●			●			
0223 _H	EXTERNNAME	●			●			
0231 _H	FONT	●			●			
0243 _H	XF	●						
027E _H	RK	●	●		●	●	●	●
0406 _H	FORMULA			●				
0409 _H	BOF			●				
041E _H	FORMAT			●	●	●	●	●
0443 _H	XF			●				
0800 _H	SCREENTIP						●	●
0809 _H	BOF				●	●	●	●
0862 _H	SHEETLAYOUT							●
0867 _H	SHEETPROTECTION							●
0868 _H	RANGEPROTECTION							●

2do: more

5.2 Overview, Ordered by Record Names

Record ID	Record name	Occurs in BIFF versions						
		2	3	4	5	7	8	8X
0040 _H	BACKUP	●	●	●	●	●	●	●
0001 _H 0201 _H	BLANK	●	●	●	●	●	●	●
0*09 _H	BOF	●	●	●	●	●	●	●
00DA _H	BOOKBOOL				●	●	●	●
0005 _H 0205 _H	BOOLERR	●	●	●	●	●	●	●
0085 _H	BOUNDSHEET				●	●	●	●
000C _H	CALCCOUNT	●	●	●	●	●	●	●
000D _H	CALCMODE	●	●	●	●	●	●	●
007D _H	COLINFO		●	●	●	●	●	●
0020 _H	COLUMNDEFAULT	●						
0024 _H	COLWIDTH	●						
003C _H	CONTINUE	●	●	●	●	●	●	●
005A _H	CRN		●	●	●	●	●	●
0051 _H	DCONREF	●	●	●	●	●	●	●
0055 _H	DEFCOLWIDTH	●	●	●	●	●	●	●
0000 _H 0200 _H	DIMENSIONS	●	●	●	●	●	●	●
01BE _H	DV					●	●	●
01B2 _H	DVAL					●	●	●
000A _H	EOF	●	●	●	●	●	●	●
0016 _H	EXTERNCOUNT	●	●	●	●	●		
0023 _H 0223 _H	EXTERNNAME	●	●	●	●	●	●	●
0017 _H	EXTERNSHHEET	●	●	●	●	●	●	●
00FF _H	EXTSST					●	●	●
002F _H	FILEPASS	●	●	●	●	●	●	●
0031 _H 0231 _H	FONT	●	●	●	●	●	●	●
001E _H 041E _H	FORMAT	●	●	●	●	●	●	●
0*06 _H	FORMULA	●	●	●	●	●	●	●
01B8 _H	HLINK					●	●	●
0002 _H	INTEGER	●						
0044 _H	IXFE	●						
0004 _H 0204 _H	LABEL	●	●	●	●	●		
015F _H	LABELRANGES					●	●	●
00FD _H	LABELSST					●	●	●
00E5 _H	MERGEDCELLS					●	●	●
00BE _H	MULBLANK				●	●	●	●
00BD _H	MULRK				●	●	●	●
0018 _H 0218 _H	NAME	●	●	●	●	●	●	●
0003 _H 0203 _H	NUMBER	●	●	●	●	●	●	●
0063 _H	OBJECTPROTECT	●	●	●	●	●	●	●
0092 _H	PALETTE	●	●	●	●	●	●	●
0013 _H	PASSWORD	●	●	●	●	●	●	●
0012 _H	PROTECT	●	●	●	●	●	●	●
0868 _H	RANGEPROTECTION						●	
027E _H	RK	●	●	●	●	●	●	●

Record ID	Record name	Occurs in BIFF versions						
		2	3	4	5	7	8	8X
00DD _H	SCENPROTECT				●	●	●	●
0800 _H	SCREENTIP						●	●
001D _H	SELECTION	●	●	●	●	●	●	●
008F _H	SHEETHDR				●			
0862 _H	SHEETLAYOUT							●
0867 _H	SHEETPROTECTION							●
008E _H	SHEETOFFSET				●			
00FC _H	SST						●	●
0007 _H 0207 _H	STRING	●	●	●	●	●	●	●
01AE _H	SUPBOOK						●	●
0019 _H	WINDOWPROTECT	●	●	●	●	●	●	●
0059 _H	XCT	●	●	●	●	●	●	●
0*43 _H 00E0 _H	XF	●	●	●	●	●	●	●
2do: more								

5.3 BACKUP

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0040 _H						

This record contains a boolean value determining whether the GUI should make backups of the file or not.

Record BACKUP, BIFF2-BIFF8:

Offset	Size	Contents
0	2	1 = Create a backup on saving

5.4 BLANK

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0001 _H	0201 _H					

This record represents an empty cell. It contains the cell address and formatting information.

Record BLANK, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)

Record BLANK, BIFF3-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)

5.5 BOF – Beginning of File

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0009 _H	0209 _H	0409 _H	0809 _H	0809 _H	0809 _H	0809 _H

The BOF record is the first record of a worksheet, the workbook globals section, a chart or a macro sheet.

Record BOF, BIFF2:

Offset	Size	Contents
0	2	Version
2	2	Type of the following data: 0010 _H = Worksheet 0020 _H = Chart 0040 _H = Macro sheet

Record BOF, BIFF3:

Offset	Size	Contents
0	2	Version
2	2	Type of the following data: 0010 _H = Worksheet 0020 _H = Chart 0040 _H = Macro sheet
4	2	Not used

Record BOF, BIFF4:

Offset	Size	Contents
0	2	Version
2	2	Type of the following data: 0010 _H = Worksheet 0020 _H = Chart 0040 _H = Macro sheet 0100 _H = Workbook globals
4	2	Not used

Record BOF, BIFF5/BIFF7:

Offset	Size	Contents
0	2	Version
2	2	Type of the following data: 0005 _H = Workbook globals 0006 _H = Visual Basic module 0010 _H = Worksheet 0020 _H = Chart 0040 _H = BIFF4 Macro sheet 0100 _H = BIFF4 Workbook globals
4	2	Build identifier
6	2	Build year

Record BOF, BIFF8/BIFF8X:

Offset	Size	Contents
0	2	Version, contains 0600 _H for BIFF8 and BIFF8X
2	2	Type of the following data: 0005 _H = Workbook globals 0006 _H = Visual Basic module 0010 _H = Worksheet 0020 _H = Chart 0040 _H = BIFF4 Macro sheet 0100 _H = BIFF4 Workbook globals
4	2	Build identifier
6	2	Build year
8	4	File history flags
12	4	Lowest Excel version that can read all records in this file

5.6 BOOKBOOL

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	00DA _H	00DA _H	00DA _H	00DA _H

This record contains a boolean value determining whether to save values linked from external workbooks (CRN (→5.15) and XCT (→5.58) records). See →4.3 for details about external references.

Record BOOKBOOL, BIFF5-BIFF8:

Offset	Size	Contents
0	2	1 = <i>Do not</i> save cached values

5.7 BOOLERR

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0005 _H	0205 _H					

This record represents a boolean value or error value cell.

Record BOOLERR, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)
7	1	Boolean or error value, depending on the following byte
8	1	0 = Boolean value; 1 = Error code

Record BOOLERR, BIFF3-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)
6	1	Boolean or error value, depending on the following byte
7	1	0 = Boolean value; 1 = Error code

If the value field is a Boolean value, it will contain 0 for FALSE and 1 for TRUE. See →2.4 for a list of error codes.

5.8 BOUNDSHEET

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	0085 _H	0085 _H	0085 _H	0085 _H

This record is located within the workbook globals area and represents a sheet inside of the workbook. For each sheet a BOUNDSHEET record is written. It stores the sheet name and an offset pointer to the BOF record (→5.5) within the workbook stream. The record is also known as BUNDLESHEET.

Record BOUNDSHEET, BIFF5-BIFF8:

Offset	Size	Contents									
0	4	Position of BOF record within the stream									
4	2	Option flags:									
		<table border="1"> <thead> <tr> <th>Bits</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>1-0</td> <td>0003_H</td> <td>Visibility: 00₂ = Visible 01₂ = Hidden 10₂ = Strong hidden (see below)</td></tr> <tr> <td>15-8</td> <td>FF00_H</td> <td>Sheet type: 00_H = Worksheet 02_H = Chart 06_H = Visual Basic module</td></tr> </tbody> </table>	Bits	Mask	Contents	1-0	0003 _H	Visibility: 00 ₂ = Visible 01 ₂ = Hidden 10 ₂ = Strong hidden (see below)	15-8	FF00 _H	Sheet type: 00 _H = Worksheet 02 _H = Chart 06 _H = Visual Basic module
Bits	Mask	Contents									
1-0	0003 _H	Visibility: 00 ₂ = Visible 01 ₂ = Hidden 10 ₂ = Strong hidden (see below)									
15-8	FF00 _H	Sheet type: 00 _H = Worksheet 02 _H = Chart 06 _H = Visual Basic module									
6	var.	Sheet name BIFF5/BIFF7: Byte string, 8-bit string length (→2.1) BIFF8: Unicode string, 8-bit string length (→2.2)									

The strong hidden flag can only be set and unset with a Visual Basic macro. It is not possible to make such a sheet visible via the user interface.

5.9 CALCCOUNT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
000C _H						

This record specifies the maximum number of times the formulas should be iteratively calculated. This is a failsafe against mutually recursive formulas locking up a spreadsheet application.

Record CALCCOUNT, BIFF2-BIFF8:

Offset	Size	Contents
0	2	Maximum number of iterations to perform

5.10 CALCMODE

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
000D _H						

This record occurs once per sheet. It specifies whether to calculate formulas manually, automatically or automatically except for tables.

Record CALCMODE, BIFF2-BIFF8:

Offset	Size	Contents
0	2	FFFF _H = automatic except for tables, 0000 _H = manually, 0001 _H = automatically (default)

5.11 COLINFO

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	007D _H					

This record specifies the width for a given range of columns. If a column does not have a corresponding COLINFO record, the width specified by the record DEFCOLWIDTH (→5.17) is used instead. This record also specifies a default XF record (→5.59) to use for cells in the columns that are not described by any cell record (which contain the XF index for that cell). Additionally, the option flags field contains hidden, outline and collapsed options that apply to the columns.

In BIFF2, the column width is stored in the record COLWIDTH (→5.13) and default column formatting in the record COLUMNDEFAULT (→5.12).

Record COLINFO, BIFF3-BIFF8:

Offset	Size	Contents	
0	2	Index to first column in the range	
2	2	Index to last column in the range	
4	2	Width of the columns in 1/256s of a character width	
6	2	Index to XF record (→5.59) for default column formatting	
8	2	Option flags:	
10	2	Bits	
		0	
		10-8	
		12	
10	2	Mask	
		0001 _H	
		0700 _H	
		1000 _H	
		Contents	
1 = Columns are hidden			
Outline level of the columns (0 = no outline)			
1 = Columns are collapsed			
Not used			

5.12 COLUMNDEFAULT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0020 _H	—	—	—	—	—	—

This record contains default formatting attributes for a given range of columns. The formatting attributes are stored separate for each column in the given range. From BIFF3 on the record COLINFO (→5.11) is used to specify default column formatting.

Record COLUMNDEFAULT, BIFF2:

Offset	Size	Contents
0	2	Index to first column referred in this record (<u>f_C</u>)
2	2	Index to last column referred in this record (<u>l_C</u>)
4	3·n _C	List of n _C =l _C -f _C +1 cell attribute structures (3 bytes each, →2.9)
4+3·n _C	2	Not used

5.13 COLWIDTH

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0024 _H	—	—	—	—	—	—

This record specifies the width for a given range of columns. If a column does not have a corresponding COLWIDTH record, the width specified by the record DEFCOLWIDTH (→5.17) is used instead. From BIFF3 on the record COLINFO (→5.11) is used to specify the column width.

Offset	Size	Contents
0	2	Width of the columns in 1/256s of a character width

5.14 CONTINUE

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
003C _H						

Everytime the content of a record exceeds the given limits (see table), the record must be split. Several CONTINUE records containing the additional data are added after the parent record.

BIFF version	Maximum data size of a record
BIFF2-BIFF7	2080 bytes (2084 bytes including record header)
BIFF8	8224 bytes (8228 bytes including record header)

Record CONTINUE, BIFF2-BIFF8:

Offset	Size	Contents
0	var.	data continuation of the previous record

Unicode strings are split in a special way. At the beginning of each CONTINUE record the option flags byte is repeated. Only the character size flag will be set in this flags byte, the Rich-Text flag and the Far-East flag are set to zero.

Attention: In each CONTINUE record it is possible that the character size changes from 8-bit-characters to 16-bit-characters and vice versa. Never an Unicode string is split between character count field and option flags field or between option flags field and first character.

Example: The remaining size of a record may be 10 bytes (it has 8214 bytes of data). Now the string “ABCDEFGHIØI” has to be stored in this record. “Ø” may be a special character with the character code 1234_H.

Note: The records are shown with their headers to make the example clearer.

Offset	Size	Contents	Description
0	2		Any record identifier
2	2	2020 _H (8224)	Record data size
4	8214		Any data
8218	2	000A _H (10)	Unicode string character count
8220	1	00 _H	Unicode string option flags (8-bit-characters)
8221	7	41 _H 42 _H ... 47 _H	8-bit-character array “ABCDEFGHI”
8228	2	003C _H	Record identifier CONTINUE
8230	2	0007 _H (7)	Record data size
8232	1	01 _H	Unicode string option flags (16-bit-characters)
8233	2	0048 _H	16-bit-character “H”
8235	2	1234 _H	16-bit-character “Ø”
8237	2	0049 _H	16-bit-character “I”

5.15 CRN

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	005A _H					

This record stores the contents of an external cell or cell range. An external cell range has one row only. If a cell range spans over more than one row, several CRN records will be created. See →4.3 for details about external references.

Record CRN, BIFF3-BIFF8:

Offset	Size	Contents
0	1	Index to last column inside of the referenced sheet (<u>lc</u>)
1	1	Index to first column inside of the referenced sheet (<u>fc</u>)
2	2	Index to row inside of the referenced sheet
4	var.	List of <u>lc-fc+1</u> cached values (→2.5)

5.16 DCONREF – Data Consolidation Reference

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0051 _H						

2do

5.17 DEFCOLWIDTH

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0055 _H						

Specifies the default column width for columns that do not have a specific width set using the record COLINFO (→5.11) or COLWIDTH (→5.13).

Record DEFCOLWIDTH, BIFF2-BIFF8:

Offset	Size	Contents
0	2	Column width measured in characters

5.18 DIMENSIONS

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0000 _H	0200 _H					

This record contains the range address of the used area in the current sheet.

Record DIMENSIONS, BIFF2:

Offset	Size	Contents
0	2	Index to first used row
2	2	Index to last used row, increased by 1
4	2	Index to first used column
6	2	Index to last used column, increased by 1

Record DIMENSIONS, BIFF3-7:

Offset	Size	Contents
0	2	Index to first used row
2	2	Index to last used row, increased by 1
4	2	Index to first used column
6	2	Index to last used column, increased by 1
8	2	Not used

Record DIMENSIONS, BIFF8:

Offset	Size	Contents
0	4	Index to first used row
4	4	Index to last used row, increased by 1
8	2	Index to first used column
10	2	Index to last used column, increased by 1
12	2	Not used

5.19 DV – Data Validation Settings

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	01BE _H	01BE _H

This record stores data validation settings and a list of cell ranges which contain these settings. The prompt box appears while editing such a cell. The error box appears, if the entered value does not fit the conditions. The data validation settings of a sheet are stored in a sequential list of DV records. This list is preluded by an DVAL record (→5.20). If a string is empty and the default text should appear in the prompt box or error box, the string has to contain a single zero character (string length will be 1).

Record DV, BIFF8:

Offset	Size	Contents
0	4	Option flags (see below)
4	var.	Title of the prompt box (Unicode string, 16-bit string length, →2.2)
var.	var.	Title of the error box (Unicode string, 16-bit string length, →2.2)
var.	var.	Text of the prompt box (Unicode string, 16-bit string length, →2.2)
var.	var.	Text of the error box (Unicode string, 16-bit string length, →2.2)
var.	2	Size of the formula data for first condition (<u>sz1</u>)
var.	2	Not used
var.	<u>sz1</u>	Formula data for first condition (RPN token array without size field, →3)
var.	2	Size of the formula data for second condition (<u>sz2</u>)
var.	2	Not used
var.	<u>sz2</u>	Formula data for second condition (RPN token array without size field, →3)
var.	var.	Cell range address list with all affected ranges (→2.10)

Option flags field:

Bit	Mask	Contents		
3-0	0000000F _H	Data type:	00 _H = Any value 01 _H = Integer values 02 _H = Decimal values 03 _H = User defined list	04 _H = Date 05 _H = Time 06 _H = Text length 07 _H = Formula
6-4	00000070 _H	Error style:	00 _H = Stop 01 _H = Warning 02 _H = Info	
7	00000080 _H	1 = In list validations the string list is explicitly given in the formula		
8	00000100 _H	1 = Empty cells allowed		
9	00000200 _H	1 = Suppress the drop down arrow in list validations		
18	00040000 _H	1 = Show prompt box if cell selected		
19	00080000 _H	1 = Show error box if invalid values entered		
23-20	00F00000 _H	Condition operator:	00 _H = Between 01 _H = Not between 02 _H = Equal 03 _H = Not equal	04 _H = Greater than 05 _H = Less than 06 _H = Greater or equal 07 _H = Less or equal

In list validations it is possible to enter an explicit string list. This string list is stored as tStr token (→3.9.2). The string items are separated by zero characters. There is no zero character at the end of the string list.

Example for a string list with the 3 strings A, B, and C: “A<00_H>B<00_H>C” (contained in a tStr token, string length is 5).

5.20 DVAL – Data Validation List

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	01B2 _H	01B2 _H

This record is the list header of all data validation records (DV, →5.19) in the current sheet.

Record DVAL, BIFF8:

Offset	Size	Contents
0	10	Unknown
10	4	Object ID of the drop down arrow object for list boxes (→6)
14	4	Number of following DV records (→5.19)

5.21 EOF – End of File

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
000A _H						

This record has no content. It indicates the end of a record block with leading BOF record (→5.5). This could be the end of the workbook globals, a worksheet, a chart, etc.

5.22 EXTERNCOUNT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0016 _H	—	—				

This record contains the number of following EXTERNSHEET records. In BIFF8 this record is omitted because there occurs only one EXTERNSHEET record. See →4.3.1 for details about external references in BIFF2-BIFF4 and →4.3.2 for BIFF5/BIFF7.

Record EXTERNCOUNT, BIFF2-BIFF7:

Offset	Size	Contents
0	2	Number of following EXTERNSHEET records (→5.24)

5.23 EXTERNNAME

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0023 _H	0223 _H	0223 _H	0023 _H	0023 _H	0023 _H	0023 _H

This record contains the name of an external defined name, the name of an AddIn function, a DDE link item or an OLE object storage name (BIFF8).

• EXTERNNAME in BIFF2-BIFF7

The meaning of the name is dependent on the leading EXTERNSHEET record (→5.24). See →4.3.1 for details about external references in BIFF2-BIFF4 and →4.3.2 for BIFF5/BIFF7.

Record EXTERNNAME, BIFF2-BIFF7:

Offset	Size	Contents
0	var.	External name (byte string, 8-bit string length, →2.1)

If the record contains an item of a DDE link, a list with cached values will be appended to the string. These values are used as results for the DDE link. They are saved row by row for a DDE link that spans over several cells. Note: Only the results of the DDE link (the contents of the referenced cells) are stored, not the results of the complete formulas.

Record EXTERNNAME for DDE items, BIFF2-BIFF7:

Offset	Size	Contents
0	var.	DDE item (byte string, 8-bit string length, →2.1)
var.	1	Number of columns (<u>nc</u>). The value 0 means 256 columns.
var.	2	Number of rows (<u>nr</u>)
var.	var.	List of <u>nc</u> · <u>nr</u> cached values (→2.5)

• EXTERNNAME in BIFF8

In BIFF8 the record contains option flags which describe the type of the external name. So, this record must follow the correct SUPBOOK record (→5.56) and must contain the correct flags. See →4.3.3 for details about external references in BIFF8.

Record EXTERNNAME for external names and AddIn functions, BIFF8:

Offset	Size	Contents
0	2	Option flags (see below)
2	2	<i>One-based</i> sheet index. The value 0 means all sheets or AddIn function.
4	2	Not used
6	var.	External name or AddIn function name (Unicode string, 8-bit string length, →2.2)
var.	var.	For external names only: formula data (RPN token array, →3)

Record EXTERNNAME for DDE links, BIFF8:

Offset	Size	Contents
0	2	Option flags (see below)
2	4	Not used
6	var.	DDE item (Unicode string, 8-bit string length, →2.2)
var.	1	Number of columns decreased by 1 (<u>nc</u>)
var.	2	Number of rows decreased by 1 (<u>nr</u>)
var.	var.	List of (<u>nc</u> +1)·(<u>nr</u> +1) cached values (→2.5)

Record EXTERNNAME for OLE object links, BIFF8:

Offset	Size	Contents
0	2	Option flags (see below)
2	4	Storage identifier
6	3	01 _H 00 _H 27 _H

Option flags:

Bit	Mask	Contents	
0	0001 _H	0 = No Built-in name	1 = Built-in name
1	0002 _H	0 = Manual DDE/OLE link	1 = Automatic DDE/OLE link
4	0010 _H	0 = External name or DDE link	1 = OLE object link
14-5	7FE0 _H	For DDE links only: clipboard format of last successful update	

5.24 EXTERNSHEET

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0017 _H						

- **EXTERNSHEET in BIFF2-BIFF7**

In the file format versions up to BIFF7 this record stores the name of an external document and a sheet name inside of this document. See →4.3.1 for details about external references in BIFF2-BIFF4 and →4.3.2 for BIFF5/BIFF7.

Record EXTERNSHEET, BIFF2-BIFF7:

Offset	Size	Contents
0	var.	Encoded document and sheet name (→2.6). Byte string, 8-bit string length (→2.1).

Attention: The string length field is decreased by 1, if the EXTERNSHEET stores a reference to one of the own sheets (first character is 03_H). Example: The formula =Sheet2!A1 contains a reference to an EXTERNSHEET record with the string “<03_H>Sheet2”. The string consists of 7 characters but the string length field contains the value 6.

If a formula uses an AddIn function, a special EXTERNSHEET record will occur, followed by an EXTERNNAME record with the name of the function.

Record EXTERNSHEET for AddIn functions, BIFF2-BIFF7:

Offset	Size	Contents
0	2	3401 _H (01 _H 34 _H = the byte string “#”)

- **EXTERNSHEET in BIFF8**

In BIFF8 the record stores a list with indexes to SUPBOOK records (list of REF structures). See →4.3.3 for details about external references in BIFF8.

Record EXTERNSHEET, BIFF8:

Offset	Size	Contents
0	2	Number of following REF structures (nm)
2	6·nm	List of nm REF structures. Each REF contains the following data:
Offset	Size	Contents
0	2	Index to SUPBOOK record
2	2	Index to first SUPBOOK sheet
4	2	Index to last SUPBOOK sheet

5.25 EXTSST – Extended SST

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	0OFF _H	0OFF _H

This record occurs in conjunction with the SST record (→5.54). It contains a hash table with stream offsets to the SST record to optimize string search operations. Excel does not shorten this record if strings are deleted from the shared string table, so the last part might contain invalid data. The stream indexes in this record divide the SST into hash buckets containing a constant number of strings. See →4.2 for more information about shared string tables.

Record EXTSST, BIFF8:

Offset	Size	Contents
0	2	Number of strings in a hash bucket, this number is ≥8
2	var.	List of OFFSET structures. Each OFFSET contains the following data:
Offset	Size	Contents
0	4	Absolute stream position of first string of this bucket
4	2	Position of first string of this bucket inside of current record, including record header. This counter restarts at zero inside of CONTINUE records.
6	2	Not used

5.26 FILEPASS

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
002F _H						

This record introduces a protected stream. All record contents following this record will be encrypted. See →4.11.2 for details.

Record FILEPASS, BIFF2-BIFF7:

Offset	Size	Contents
0	2	Encryption key calculated from the password (→4.11.4)
2	2	Hash value calculated from the password (→4.11.3)

Record FILEPASS, BIFF8:

Offset	Size	Contents
0	2do	

5.27 FONT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0031 _H	0231 _H	0231 _H	0031 _H	0031 _H	0031 _H	0031 _H

This record contains information about an used font, including character formatting. All FONT records occur together in a sequential list. Other records referencing a FONT record contain a zero-based index into this list.

Some of the elements occur unchanged in every BIFF version. These elements are described in the following tables using a specific name for each element. In the description of the record structure the names are used to reference to these tables.

5.27.1 FONT Substructures

- **FONT_SCRIPT – Subscript or superscript (2 bytes), BIFF5-BIFF8**

Value	Contents
0000 _H	None
0001 _H	Superscript
0002 _H	Subscript

- **FONT_UNDERLINE – Underline type (1 byte), BIFF5-BIFF8**

Value	Contents
00 _H	None
01 _H	Single
02 _H	Double
03 _H	Single accounting
04 _H	Double accounting

5.27.2 FONT Record Contents

Record FONT, BIFF2:

Offset	Size	Contents															
0	2	Height of the font (in 1/20 th of a point)															
2	2	Option flags: <table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0001_H</td> <td>1 = Characters are bold</td> </tr> <tr> <td>1</td> <td>0002_H</td> <td>1 = Characters are italic</td> </tr> <tr> <td>2</td> <td>0004_H</td> <td>1 = Characters are underlined</td> </tr> <tr> <td>3</td> <td>0008_H</td> <td>1 = Characters are struck out</td> </tr> </tbody> </table>	Bit	Mask	Contents	0	0001 _H	1 = Characters are bold	1	0002 _H	1 = Characters are italic	2	0004 _H	1 = Characters are underlined	3	0008 _H	1 = Characters are struck out
Bit	Mask	Contents															
0	0001 _H	1 = Characters are bold															
1	0002 _H	1 = Characters are italic															
2	0004 _H	1 = Characters are underlined															
3	0008 _H	1 = Characters are struck out															
4	var.	Font name (byte string, 8-bit string length, →2.1)															

Record FONT, BIFF3-BIFF4:

Offset	Size	Contents															
0	2	Height of the font (in 1/20 th of a point)															
2	2	Option flags: <table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0001_H</td> <td>1 = Characters are bold</td> </tr> <tr> <td>1</td> <td>0002_H</td> <td>1 = Characters are italic</td> </tr> <tr> <td>2</td> <td>0004_H</td> <td>1 = Characters are underlined</td> </tr> <tr> <td>3</td> <td>0008_H</td> <td>1 = Characters are struck out</td> </tr> </tbody> </table>	Bit	Mask	Contents	0	0001 _H	1 = Characters are bold	1	0002 _H	1 = Characters are italic	2	0004 _H	1 = Characters are underlined	3	0008 _H	1 = Characters are struck out
Bit	Mask	Contents															
0	0001 _H	1 = Characters are bold															
1	0002 _H	1 = Characters are italic															
2	0004 _H	1 = Characters are underlined															
3	0008 _H	1 = Characters are struck out															
4	2	Index into PALETTE record (→5.42)															
6	var.	Font name (byte string, 8-bit string length, →2.1)															

Record FONT, BIFF5-BIFF8:

Offset	Size	Contents									
0	2	Height of the font (in 1/20 th of a point)									
2	2	Option flags: <table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0002_H</td> <td>1 = Characters are italic</td> </tr> <tr> <td>3</td> <td>0008_H</td> <td>1 = Characters are struck out</td> </tr> </tbody> </table>	Bit	Mask	Contents	1	0002 _H	1 = Characters are italic	3	0008 _H	1 = Characters are struck out
Bit	Mask	Contents									
1	0002 _H	1 = Characters are italic									
3	0008 _H	1 = Characters are struck out									
4	2	Index into PALETTE record (→5.42)									
6	2	Boldness (100-1000). Standard values are 0190 _H (400) for normal text and 02BC _H (700) for bold text.									
8	2	FONT_SCRIPT – Subscript or superscript (see above)									
10	1	FONT_UNDERLINE – Underline type (see above)									
11	1	Font family...									
12	1	Character set...									
13	1	Not used									
14	var.	Font name: BIFF5/BIFF7: Byte string, 8-bit string length (→2.1) BIFF8: Unicode string, 8-bit string length (→2.2)									

5.28 FORMAT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
001E _H	001E _H	041E _H				

This record contains information about a number format. All FORMAT records occur together in a sequential list.

In BIFF2-BIFF4 other records referencing a FORMAT record contain a zero-based index into this list. From BIFF5 on the FORMAT record contains the index itself that will be used by other records.

From BIFF5 on, the built-in number formats will be omitted. The built-in formats may differ in localized versions of Excel (for instance: A cell with the built-in format D-MMM-YY occurs as D.MMM.YY in a German version of Excel).

Record FORMAT, BIFF2-BIFF3:

Offset	Size	Contents
0	var.	Number format string (byte string, 8-bit string length, →2.1)

Record FORMAT, BIFF4-BIFF7:

Offset	Size	Contents
0	2	BIFF4: Not used, BIFF5/BIFF7: Format index used in other records
2	var.	Number format string (byte string, 8-bit string length, →2.1)

5 Worksheet/Workbook Records

Record FORMAT, BIFF8:

Offset	Size	Contents
0	2	Format index used in other records
2	var.	Number format string (Unicode string, 16-bit string length, →2.2)

The built-in number formats (English version), BIFF5-BIFF8:

Index	Type	Format string	Index	Type	Format string
00 _H	General	General	12 _H	Time	h:mm AM/PM
01 _H	Decimal	0	13 _H	Time	h:mm:ss AM/PM
02 _H	Decimal	0.00	14 _H	Time	h:mm
03 _H	Decimal	###0	15 _H	Time	h:mm:ss
04 _H	Decimal	#,##0.00	16 _H	Date/Time	M/D/YY h:mm
09 _H	Percent	0%	25 _H	Currency	_(#,##0_);(#,##0)
0A _H	Percent	0.00%	26 _H	Currency	_(#,##0_);[Red](#,##0)
0B _H	Scientific	0.00E+00	27 _H	Currency	_(#,##0.00_);(#,##0.00)
0C _H	Fraction	# ?/?	28 _H	Currency	_(#,##0.00_);[Red](#,##0.00)
0D _H	Fraction	# ??/??	2D _H	Time	mm:ss
0E _H	Date	M/D/YY	2E _H	Time	[h]:mm:ss
0F _H	Date	D-MMM-YY	2F _H	Time	mm:ss.0
10 _H	Date	D-MMM	30 _H	Scientific	##0.0E+0
11 _H	Date	MMM-YY	31 _H	Text	@

5.29 FORMULA

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0006 _H	0206 _H	0406 _H	0006 _H	0006 _H	0006 _H	0006 _H

This record contains the token array and the result of a formula cell.

- Record contents

Record FORMULA, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)
7	8	Result of the formula (IEEE floating-point value)
15	1	0 = Do not recalculate, 1 = Recalculate always
16	var.	Formula data (RPN token array, →3)

Record FORMULA, BIFF3-BIFF4:

Offset	Size	Contents									
0	2	Index to row									
2	2	Index to column									
4	2	Index to XF record (\rightarrow 5.59)									
6	8	Result of the formula. See below for details.									
14	2	Option flags:									
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0001_H</td> <td>1 = Recalculate always</td> </tr> <tr> <td>1</td> <td>0002_H</td> <td>1 = Calculate on open</td> </tr> </tbody> </table>	Bit	Mask	Contents	0	0001 _H	1 = Recalculate always	1	0002 _H	1 = Calculate on open
Bit	Mask	Contents									
0	0001 _H	1 = Recalculate always									
1	0002 _H	1 = Calculate on open									
16	var.	Formula data (RPN token array, \rightarrow 3)									

Record FORMULA, BIFF5-BIFF8:

Offset	Size	Contents												
0	2	Index to row												
2	2	Index to column												
4	2	Index to XF record (\rightarrow 5.59)												
6	8	Result of the formula. See below for details.												
14	2	Option flags:												
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0001_H</td> <td>1 = Recalculate always</td> </tr> <tr> <td>1</td> <td>0002_H</td> <td>1 = Calculate on open</td> </tr> <tr> <td>3</td> <td>0008_H</td> <td>1 = Part of a shared formula</td> </tr> </tbody> </table>	Bit	Mask	Contents	0	0001 _H	1 = Recalculate always	1	0002 _H	1 = Calculate on open	3	0008 _H	1 = Part of a shared formula
Bit	Mask	Contents												
0	0001 _H	1 = Recalculate always												
1	0002 _H	1 = Calculate on open												
3	0008 _H	1 = Part of a shared formula												
16	4	Not used												
20	var.	Formula data (RPN token array, \rightarrow 3)												

• Result of the formula

Dependent on the type of value the formula returns, the result field has the following format:

Result is a numeric value:

Offset	Size	Contents
0	8	IEEE floating-point value

Result is a string (the string follows in a STRING record, \rightarrow 5.55):

Offset	Size	Contents
0	1	00 _H (identifier for a string value)
1	5	Not used
6	2	FFFF _H

Result is a Boolean value:

Offset	Size	Contents
0	1	01 _H (identifier for a Boolean value)
1	1	Not used
2	1	0 = FALSE, 1 = TRUE
3	3	Not used
6	2	FFFF _H

Result is an error value:

Offset	Size	Contents
0	1	02 _H (identifier for an error value)
1	1	Not used
2	1	Error code (→2.4)
3	3	Not used
6	2	FFFF _H

5.30 HLINK – Hyperlink

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	01B8 _H	01B8 _H

In Excel, every cell may contain a hyperlink. The HLINK record refers to one cell address or a cell range where all cells contain the same hyperlink. Every hyperlink can contain a text mark and a description that is shown in the sheet instead of the real link. Text marks are appended behind a link, separated by the hash sign (“#”).

■ Examples for text marks: www.example.org#table1 or C:\example.xls#Sheet1!A1.

Inside of this record strings are stored in several formats. Sometimes occurs the character count, otherwise the character array size (in 16-bit-character arrays the character count is half of the array size). Furthermore some strings are zero-terminated, others not. They are stored either as 16-bit-character arrays or as 8-bit-character arrays, independent of the characters.

5.30.1 Common Record Contents

Each HLINK record starts with the same data items and continues with special data related to the current type of hyperlink. It starts with a cell range. Each cell of this range will contain the same hyperlink.

Record HLINK, BIFF8:

Offset	Size	Contents
0	2	Index to first row
2	2	Index to last row
4	2	Index to first column
6	2	Index to last column
8	16	GUID of StdLink: D0 _H C9 _H EA _H 79 _H F9 _H BA _H CE _H 11 _H 8C _H 82 _H 00 _H AA _H 00 _H 4B _H A9 _H 0B _H (79EAC9D0-BAF9-11CE-8C82-00AA004BA90B)
24	4	Unknown value: 00000002 _H
28	4	Option flags (see below)
[32]	4	(optional, see option flags) Character count of description text, including trailing zero word (d _L)
[36]	2·d _L	(optional, see option flags) Character array of description text, no Unicode string header, always 16-bit-characters, zero-terminated
[var.]	4	(optional, see option flags) Character count of target frame, including trailing zero word (f _L)
[var.]	2·f _L	(optional, see option flags) Character array of target frame, no Unicode string header, always 16-bit-characters, zero-terminated
		Special data (→5.30.2 and following)
[var.]	4	(optional, see option flags) Character count of the text mark, including trailing zero word (t _L)
[var.]	2·t _L	(optional, see option flags) Character array of the text mark without “#” sign, no Unicode string header, always 16-bit-characters, zero-terminated

The special data parts in the following are described with relative offsets (starting again by zero). The real offset inside of the record data (without header) is either 32 (without description) or $36+2 \cdot d_1$ (with description).

- **Option flags**

The option flags specify the following content of the record.

Bit	Mask	Contents	
0	00000001 _H	0 = No link extant	1 = File link or URL
1	00000002 _H	0 = Relative file path	1 = Absolute path or URL
2 and 4	00000014 _H	0 = No description	1 (both bits) = Description
3	00000008 _H	0 = No text mark	1 = Text mark
7	00000080 _H	0 = No target frame	1 = Target frame
8	00000100 _H	0 = File link or URL	1 = UNC path (incl. server name)

5.30.2 Hyperlink to an URL (Uniform Resource Locator)

These data fields occur for links which are not local files or files in the local network (for instance HTTP and FTP links and e-mail addresses). The lower 9 bits of the option flags field must be $0.x00x.xx11_2$ (x means optional, depending on hyperlink content). The GUID could be used to distinguish an URL from a file link.

Offset	Size	Contents
0	16	GUID of URL Moniker: E0 _H C9 _H EA _H 79 _H F9 _H BA _H CE _H 11 _H 8C _H 82 _H 00 _H AA _H 00 _H 4B _H A9 _H 0B _H (79EAC9E0-BAF9-11CE-8C82-00AA004BA90B)
16	4	Size of character array of the URL, including trailing zero word (<u>us</u>). There are <u>us</u> /2-1 characters in the following string.
20	<u>us</u>	Character array of the URL, no Unicode string header, always 16-bit-characters, zero-terminated

5.30.3 Hyperlink to a Local File

These data fields are for links to files on local drives. The path of the file can be complete with drive letter (absolute) or relative to the location of the workbook. The lower 9 bits of the option flags field must be $0.x00x.xxx1_2$. The GUID could be used to distinguish an URL from a file link.

Offset	Size	Contents
0	16	GUID of File Moniker: 03 _H 03 _H 00 _H 00 _H 00 _H 00 _H 00 _H 00 _H C0 _H 00 _H 00 _H 00 _H 00 _H 00 _H 46 _H (00000303-0000-0000-C000-000000000046)
16	2	Directory up-level count. Each leading “..\\” in the file link is deleted and increases this counter.
18	4	Character count of the shortened file path and name, including trailing zero byte (<u>s1</u>)
22	<u>s1</u>	Character array of the shortened file path and name in 8.3-DOS-format. This field can be filled with a long file name too. No Unicode string header, always 8-bit-characters, zero-terminated.
22+ <u>s1</u>	24	Unknown byte sequence: FF _H FF _H AD _H DE _H 00 _H 00 _H 00 _H 00 _H 00 _H 00 _H 00 _H 00 _H
46+ <u>s1</u>	4	Size of the following file link field including string length field and additional data field (<u>sz</u>). If <u>sz</u> is zero, nothing will follow (except a text mark).
[50+ <u>s1</u>]	4	(optional) Size of character array of the extended file path and name (<u>x1</u>). There are <u>x1</u> /2 characters in the following string.
[54+ <u>s1</u>]	2	(optional) Unknown byte sequence: 03 _H 00 _H
[56+ <u>s1</u>]	<u>x1</u>	(optional) Character array of the extended file path and name (<u>x1</u>), no Unicode string header, always 16-bit-characters, <i>not</i> zero-terminated

5.30.4 Hyperlink to a File with UNC (Universal Naming Convention) Path

These data fields are for UNC paths containing a server name (for instance “\\server\\path\\file.xls”). The lower 9 bits of the option flags field must be $1.x00x.xx11_2$.

Offset	Size	Contents
0	4	Character count of the UNC, including trailing zero word (<u>f1</u>)
4	2· <u>f1</u>	Character array of the UNC, no Unicode string header, always 16-bit-characters, zero-terminated.

5.30.5 Hyperlink to the Current Workbook

In this case only the text mark field is present (optional with description).

Example: The URL “#Sheet2!B1:C2” refers to the given range in the current workbook.

The lower 9 bits of the option flags field must be $0.x00x.1x00_2$.

5.31 INTEGER

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0002 _H	—	—	—	—	—	—

This record represents a cell that contains an unsigned 16-bit-integer value. If a value cannot be stored as a 16-bit-integer, a NUMBER record (→5.40) must be written. From BIFF3 on this record is replaced by the RK record (→5.46).

Record INTEGER, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)
7	2	Unsigned 16-bit-integer value

5.32 IXFE – Index to XF

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0044 _H	—	—	—	—	—	—

This record occurs in front of every cell record (for instance BLANK, INTEGER, NUMBER, LABEL, FORMULA) that references to an XF record (→5.59) with an index greater than 62. The XF index field of the cell record consists only of 6 bits. The maximum value 63 is used to indicate a preceding IXFE record containing the real XF index. See →2.9 for more details.

Record IXFE, BIFF2:

Offset	Size	Contents
0	2	Index to XF record (→5.59)

5.33 LABEL

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0004 _H	0204 _H	0204 _H	0204 _H	0204 _H	—	—

This record represents a cell that contains a string. In BIFF8 it is replaced by the LABELSST record (→5.35).

Record LABEL, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)
7	var.	Byte string, 8-bit string length (→2.1)

Record LABEL, BIFF3-BIFF7:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)
6	var.	Byte string, 16-bit string length (→2.1)

5.34 LABELRANGES

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	015F _H	015F _H

This record contains the addresses of all row and column label ranges.

Record LABELRANGES, BIFF8:

Offset	Size	Contents
0	var.	Cell range address list with all row label ranges (→2.10)
var.	var.	Cell range address list with all column label ranges (→2.10)

5.35 LABELSST

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	00FD _H	00FD _H

This record represents a cell that contains a string. It replaces the LABEL record (→5.33) used in BIFF2-BIFF7. See →4.2 for more information about shared string tables.

Record LABELSST, BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)
6	4	Index into SST record (→5.54)

5.36 MERGEDCELLS

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	00E5 _H	00E5 _H

This record contains all merged cell ranges of the current sheet.

Record MERGEDCELLS, BIFF8:

Offset	Size	Contents
0	var.	Cell range address list with all merged ranges (→2.10)

5.37 MULBLANK – Multiple BLANK

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	00BE _H	00BE _H	00BE _H	00BE _H

This record represents a cell range of empty cells. All cells are located in the same row.

Record MULBLANK, BIFF5-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to first column (f_c)
4	$2 \cdot n_c$	List of $n_c = l_c - f_c + 1$ 16-bit-indexes to XF records (→5.59)
$4 + 2 \cdot n_c$	2	Index to last column (l_c)

5.38 MULRK – Multiple RK

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	00BD _H	00BD _H	00BD _H	00BD _H

This record represents a cell range containing RK value cells. All cells are located in the same row.

Record MULRK, BIFF5-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to first column (f_c)
4	$6 \cdot n_c$	List of $n_c = l_c - f_c + 1$ XF/RK structures. Each XF/RK contains:
Offset	Size	Contents
0	2	Index to XF record (→5.59)
2	4	RK value (→2.3)
$4 + 6 \cdot n_c$	2	Index to last column (l_c)

5.39 NAME

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0018 _H	0218 _H	0218 _H	0018 _H	0018 _H	0018 _H	0018 _H

This record contains the name and the token array of an internal defined name. Token arrays of defined names contain tokens with aberrant token classes (→3.3).

Record NAME, BIFF2:

Offset	Size	Contents									
0	1	Option flags: <table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>02_H</td> <td>1 = Function macro or command macro</td> </tr> <tr> <td>2</td> <td>04_H</td> <td>1 = Complex function (array formula or user defined)</td> </tr> </tbody> </table>	Bit	Mask	Contents	1	02 _H	1 = Function macro or command macro	2	04 _H	1 = Complex function (array formula or user defined)
Bit	Mask	Contents									
1	02 _H	1 = Function macro or command macro									
2	04 _H	1 = Complex function (array formula or user defined)									
1	1	If name is function macro or command macro (see option flags above): 01 _H = Function macro, 02 _H = Command macro									
2	1	Keyboard shortcut									
3	1	Length of the name (character count) (<u>ln</u>)									
4	1	Size of the formula data (<u>sz</u>)									
5	<u>ln</u>	Character array of the name									
5+ <u>ln</u>	<u>sz</u>	Formula data (RPN token array without size field, →3)									
5+ <u>ln+sz</u>	1	Duplicate of the formula data size field (<u>sz</u>)									

Record NAME, BIFF3-BIFF4:

Offset	Size	Contents																								
0	2	Option flags: <table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0001_H</td> <td>1 = Name is hidden</td> </tr> <tr> <td>1</td> <td>0002_H</td> <td>1 = Name is a function</td> </tr> <tr> <td>2</td> <td>0004_H</td> <td>1 = Name is a command</td> </tr> <tr> <td>3</td> <td>0008_H</td> <td>1 = Function macro or command macro</td> </tr> <tr> <td>4</td> <td>0010_H</td> <td>1 = Complex function (array formula or user defined)</td> </tr> <tr> <td>5</td> <td>0020_H</td> <td>1 = Built-in name (see table below)</td> </tr> <tr> <td>11-6</td> <td>0FC0_H</td> <td>BIFF3: Not used; BIFF4: Index to function group</td> </tr> </tbody> </table>	Bit	Mask	Contents	0	0001 _H	1 = Name is hidden	1	0002 _H	1 = Name is a function	2	0004 _H	1 = Name is a command	3	0008 _H	1 = Function macro or command macro	4	0010 _H	1 = Complex function (array formula or user defined)	5	0020 _H	1 = Built-in name (see table below)	11-6	0FC0 _H	BIFF3: Not used; BIFF4: Index to function group
Bit	Mask	Contents																								
0	0001 _H	1 = Name is hidden																								
1	0002 _H	1 = Name is a function																								
2	0004 _H	1 = Name is a command																								
3	0008 _H	1 = Function macro or command macro																								
4	0010 _H	1 = Complex function (array formula or user defined)																								
5	0020 _H	1 = Built-in name (see table below)																								
11-6	0FC0 _H	BIFF3: Not used; BIFF4: Index to function group																								
2	1	Keyboard shortcut																								
3	1	Length of the name (character count) (<u>ln</u>)																								
4	2	Size of the formula data (<u>sz</u>)																								
6	<u>ln</u>	Character array of the name																								
6+ <u>ln</u>	<u>sz</u>	Formula data (RPN token array without size field, →3)																								

Record NAME, BIFF5/BIFF7:

Offset	Size	Contents									
0	2	Option flags: <table border="1"> <thead> <tr> <th>Bit</th><th>Mask</th><th>Contents</th></tr> </thead> <tbody> <tr> <td>11-0</td><td>0FFF_H</td><td>Equal to BIFF4 (see table above)</td></tr> <tr> <td>12</td><td>1000_H</td><td>1 = Name contains binary data</td></tr> </tbody> </table>	Bit	Mask	Contents	11-0	0FFF _H	Equal to BIFF4 (see table above)	12	1000 _H	1 = Name contains binary data
Bit	Mask	Contents									
11-0	0FFF _H	Equal to BIFF4 (see table above)									
12	1000 _H	1 = Name contains binary data									
2	1	Keyboard shortcut									
3	1	Length of the name (character count) (<u>ln</u>)									
4	2	Size of the formula data (<u>sz</u>)									
6	2	Unused									
8	2	0 = Global name, otherwise index to sheet (<i>one-based</i>)									
10	1	Length of menu text (character count) (<u>lm</u>)									
11	1	Length of description text (character count) (<u>ld</u>)									
12	1	Length of help topic text (character count) (<u>lh</u>)									
13	1	Length of status bar text (character count) (<u>ls</u>)									
14	<u>ln</u>	Character array of the name									
14+ <u>ln</u>	<u>sz</u>	Formula data (RPN token array without size field, →3)									
14+ <u>ln</u> + <u>sz</u>	<u>lm</u>	Character array of menu text									
var.	<u>ld</u>	Character array of description text									
var.	<u>lh</u>	Character array of help topic text									
var.	<u>ls</u>	Character array of status bar text									

Record NAME, BIFF8:

Offset	Size	Contents
0	2	Option flags: Equal to BIFF5/BIFF7 (see table above)
2	1	Keyboard shortcut
3	1	Length of the name (character count)
4	2	Size of the formula data (<u>sz</u>)
6	2	Unused
8	2	0 = Global name, otherwise index to sheet (<i>one-based</i>)
10	1	Length of menu text (character count)
11	1	Length of description text (character count)
12	1	Length of help topic text (character count)
13	1	Length of status bar text (character count)
14	var.	Name (Unicode string without length field, →2.2)
var.	<u>sz</u>	Formula data (RPN token array without size field, →3)
var.	var.	Menu text (Unicode string without length field, →2.2)
var.	var.	Description text (Unicode string without length field, →2.2)
var.	var.	Help topic text (Unicode string without length field, →2.2)
var.	var.	Status bar text (Unicode string without length field, →2.2)

- **Built-in names**

From BIFF3 on only an index to a built-in names is stored. If bit 5 of the option flags field is set, the name string contains only one character with this index.

Index	Built-in name	Index	Built-in name
00 _H	Consolidate_Area	08 _H	Recorder
01 _H	Auto_Open	09 _H	Data_Form
02 _H	Auto_Close	0A _H	Auto_Activate
03 _H	Extract	0B _H	Auto_Deactivate
04 _H	Database	0C _H	Sheet_Title
05 _H	Criteria	0D _H	Autofilter (BIFF5-BIFF8 only)
06 _H	Print_Area		
07 _H	Pint_Titles		

5.40 NUMBER

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0003 _H	0203 _H					

This record represents a cell that contains a floating-point value.

Record NUMBER, BIFF2:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	3	Cell attributes (→2.9)
7	8	IEEE floating-point value

Record NUMBER, BIFF3-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)
6	8	IEEE floating-point value

5.41 OBJECTPROTECT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	0063 _H					

This record determines whether the objects of the current sheet are protected. Object protection is not active, if this record is omitted. See →4.11.1 for more information.

Record OBJECTPROTECT, BIFF3-BIFF8:

Offset	Size	Contents
0	2	0 = Objects not protected; 1 = Objects protected

5.42 PALETTE

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	0092 _H					

This record contains the definition of all colors available for cell and object formatting.

Record PALETTE, BIFF3-BIFF8:

Offset	Size	Contents
0	2	Number of following colors (<u>nm</u>). Contains 16 in BIFF3-BIFF4 and 56 in BIFF5-BIFF8.
2	4·nm	List of <u>nm</u> colors. Each color contains:
Offset	Size	Contents
0	1	Red component of the color
1	1	Green component of the color
2	1	Blue component of the color
3	1	Not used

5.43 PASSWORD

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0013 _H						

This record stores a 16-bit hash value for a worksheet or workbook protection password. See →4.11.1 for more information.

Offset	Size	Contents
0	2	16-bit hash value of the password (→4.11.3)

This is the algorithm to create the hash value from a given password:

- The ASCII values of all characters are rotated left with a number of digits depending on the character position (first character is rotated left 1 bit, second character 2 bits, and so on). There is a space of 15 bits available for rotation (bit 15 jumps to bit 0, bit 16 jumps to bit 1 and so on).
- All rotated characters are combined using XOR operation.
- The number of characters is added using XOR operation.
- The constant CE4B_H is added using XOR operation.

Example: The password is “abcdefghijkl” (10 characters).

Character	ASCII	Shifted	Rotated
a	61 _H	000000C2 _H	00C2 _H
b	62 _H	00000188 _H	0188 _H
c	63 _H	00000318 _H	0318 _H
d	64 _H	00000640 _H	0640 _H
e	65 _H	00000CA0 _H	0CA0 _H
f	66 _H	00001980 _H	1980 _H
g	67 _H	00003380 _H	3380 _H
h	68 _H	00006800 _H	6800 _H
i	69 _H	0000D200 _H	5201 _H
j	6A _H	0001A800 _H	2803 _H

All the rotated values and the number of characters 000A_H and the constant CE4B_H result in the hash value FEF1_H.

5.44 PROTECT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0012 _H						

This record specifies whether a worksheet or a workbook are protected against modification. Protection is not active, if this record is omitted. See →4.11.1 for more information.

Record PROTECT, BIFF2-BIFF8:

Offset	Size	Contents
0	2	0 = Not protected; 1 = Protected

5.45 RANGEPROTECTION

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	—	0868 _H

This record stores information about special protected ranges in a protected sheet. See →4.11.1 for more information.

Record RANGEPROTECTION, BIFF8X:

Offset	Size	Contents
0	2	0868 _H (repeated record ID)
2		2do

5.46 RK

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	027E _H					

This record represents a cell that contains an RK value (encoded integer or floating-point value). If a floating-point value cannot be encoded to an RK value, a NUMBER record (→5.40) must be written. This record replaces the record INTEGER (→5.31) written in BIFF2.

Record RK, BIFF3-BIFF8:

Offset	Size	Contents
0	2	Index to row
2	2	Index to column
4	2	Index to XF record (→5.59)
6	4	RK value (→2.3)

5.47 SCENPROTECT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	00DD _H	00DD _H	00DD _H	00DD _H

This record determines whether the scenarios of the current sheet are protected. Scenario protection is not active, if this record is omitted. See →4.11.1 for more information.

Record SCENPROTECT, BIFF5-BIFF8:

Offset	Size	Contents
0	2	0 = Scenarios not protected; 1 = Scenarios protected

5.48 SCREENTIP

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	0800 _H	0800 _H

This record contains the cell range and text for a screen tip. It occurs in conjunction with the HLINK record for hyperlinks (→5.30). This record is only available in Excel 9.0 (Excel 2000) and later.

Record SCREENTIP, BIFF8:

Offset	Size	Contents
0	2	0800 _H (repeated record ID)
2	2	Index to first row
4	2	Index to last row
6	2	Index to first column
8	2	Index to last column
10	var.	Character array of the screen tip, no Unicode string header, always 16-bit-characters, zero-terminated

5.49 SELECTION

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
001D _H						

This record contains the addresses of all selected cell ranges and the position of the active cell for a split pane in the current sheet.

Record SELECTION, BIFF2-BIFF8:

Offset	Size	Contents
0	1	Index to window pane:
1	2	Index to row of the active cell
3	2	Index to column of the active cell
5	2	Index into the following cell range list to the entry that contains the active cell
7	2	Number of following ADDR structures (nm)
9	6·nm	List of nm ADDR structures. Each ADDR contains the address of a selected cell range:
Offset	Size	Contents
0	2	Index to first row
2	2	Index to last row
4	1	Index to first column
5	1	Index to last column

5.50 SHEETHDR

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	008F _H	—	—	—	—

This record occurs only in BIFF4 workbook files. It precedes a worksheet substream (delimited by a BOF and a EOF record) and contains the byte length of the substream and the sheet name. Adding the substream length to the stream position of the following BOF record gives the position of the next SHEETHDR record. See →4.1.2 for details about the BIFF4 workbook stream.

Record SHEETHDR, BIFF4:

Offset	Size	Contents
0	4	Byte length of the following sheet substream
4	var.	Name of the sheet (byte string, 8-bit string length, →2.1)

5.51 SHEETLAYOUT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	—	0862 _H

This record stores the color of the tab below the sheet containing the sheet name.

Record SHEETLAYOUT, BIFF8X:

Offset	Size	Contents
0	2	0862 _H (repeated record ID)
2	10	Not used
12	4	Unknown data: 14 _H 00 _H 00 _H 00 _H
16	2	Index into PALETTE record (→5.42)
18	2	Not used

5.52 SHEETPROTECTION

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	—	0867 _H

This record stores additional options for sheet protection. See →4.11.1 for more information.

Record SHEETPROTECTION, BIFF8X:

Offset	Size	Contents
0	2	0867 _H (repeated record ID)
2	9	Not used
11	8	Unknown data: 02 _H 00 _H 01 _H 00 _H FF _H FF _H FF _H FF _H
19	2	Option flags, see below (default: 4400 _H)
21	2	Not used

The following flags specify, which actions are allowed while the sheet is protected. The state of object and scenario protection is also contained in the records OBJECTPROTECT (→5.41) and SCENPROTECT (→5.47). These records are stored for compatibility to Excel 97 and Excel 2000.

Option flags for sheet protection (a set bit specifies that the action is allowed):

Bit	Mask	Contents	Bit	Mask	Contents
0	0001 _H	Edit objects	8	0100 _H	Delete columns
1	0002 _H	Edit scenarios	9	0200 _H	Delete rows
2	0004 _H	Change cell formatting	10	0400 _H	Select locked cells
3	0008 _H	Change column formatting	11	0800 _H	Sort a cell range
4	0010 _H	Change row formatting	12	1000 _H	Edit auto filters
5	0020 _H	Insert columns	13	2000 _H	Edit PivotTables
6	0040 _H	Insert rows	14	4000 _H	Select unlocked cells
7	0080 _H	Insert hyperlinks			

5.53 SHEETOFFSET

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	008E _H	—	—	—	—

This record occurs only in BIFF4 workbook files. It is located in the workbook globals section and contains the stream position of the first SHEETHDR record (→5.50). See →4.1.2 for details about the BIFF4 workbook stream.

Record SHEETOFFSET, BIFF4:

Offset	Size	Contents
0	4	Stream position of the first SHEETHDR record

5.54 SST – Shared String Table

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	00FC _H	00FC _H

This record contains a list of all strings used anywhere in the workbook. Each string occurs only once. The workbook uses indexes into the list to reference the strings. See →4.2 for more information.

Record SST, BIFF8:

Offset	Size	Contents
0	4	Total number of strings in the workbook (see below)
4	4	Number of following strings (nm)
8	var.	List of nm Unicode strings, 16-bit string length (→2.2)

The first field of the SST record counts the total occurrence of strings in the workbook. For instance, the string “AAA” is used 3 times and the string “BBB” is used 2 times. The first field contains 5 and the second field contains 2, followed by the two strings.

5.55 STRING

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0007 _H	0207 _H					

This record stores the result of a string formula. It occurs directly after a string formula (→5.29).

Record STRING, BIFF2:

Offset	Size	Contents
0	var.	Byte string, 8-bit string length (→2.1)

Record STRING, BIFF3-BIFF7:

Offset	Size	Contents
0	var.	Byte string, 16-bit string length (→2.1)

In BIFF8 files the whole record is omitted, if the result is an empty string.

Record STRING, BIFF8:

Offset	Size	Contents
0	var.	Unicode string with at least 1 character, 16-bit string length (→2.2)

5.56 SUPBOOK – External Workbook

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	—	—	—	—	01AE _H	01AE _H

This record mainly stores the name of an external document and a list of sheet names inside of this document. Furthermore it is used to store names of documents for DDE and OLE object links or to indicate an internal 3D reference or an AddIn function. See →4.3.3 for details about external references in BIFF8.

5.56.1 External References

A SUPBOOK record for external references stores the name of the document and a list of sheet names.

Record SUPBOOK for external references, BIFF8:

Offset	Size	Contents
0	2	Number of sheet names (<u>nm</u>)
2	var.	Encoded document name without sheet name (→2.6.1). Unicode string, 16-bit string length (→2.2).
var.	var.	List of <u>nm</u> sheet names (Unicode strings with 16-bit string length, →2.2)

5.56.2 Internal References

In each file occurs a SUPBOOK that is used for internal 3D references. It stores the number of sheets of the own document.

Record SUPBOOK for 3D references, BIFF8:

Offset	Size	Contents
0	2	Number of sheets in this document
2	2	0401 _H

5.56.3 AddIn Functions

AddIn function names are stored in EXTERNNAME records following this SUPBOOK record.

Record SUPBOOK for AddIn functions, BIFF8:

Offset	Size	Contents
0	2	0001 _H
2	2	3A01 _H

5.56.4 DDE Links, OLE Object Links

The SUPBOOK record of a DDE link or an OLE object link contains the name of the server application (DDE) or the class name (OLE) and the name of a source document. These names are encoded in one string.

Record SUPBOOK for DDE links and OLE object links, BIFF8:

Offset	Size	Contents
0	2	0000 _H
2	var.	Encoded source document name (→2.6.2). Unicode string, 16-bit string length (→2.2).

5.57 WINDOWPROTECT

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0019 _H						

This record determines whether the window configuration of this document is protected. Window protection is not active, if this record is omitted. See →4.11.1 for more information.

Record WINDOWPROTECT, BIFF2-BIFF8:

Offset	Size	Contents
0	2	0 = Window settings not protected; 1 = Window settings protected

5.58 XCT – CRN Count

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
—	0059 _H					

This record stores the number of immediately following CRN records. These records are used to store the cell contents of external references. See →4.3 for details about of external references.

Record XCT, BIFF3-BIFF7:

Offset	Size	Contents
0	2	Number of following CRN records (→5.15)

Record XCT, BIFF8:

Offset	Size	Contents
0	2	Number of following CRN records (→5.15)
2	2	Index into sheet table of the involved SUPBOOK record (→5.56)

5.59 XF – Extended Format

BIFF2	BIFF3	BIFF4	BIFF5	BIFF7	BIFF8	BIFF8X
0043 _H	0243 _H	0443 _H	00E0 _H	00E0 _H	00E0 _H	00E0 _H

This record contains formatting information for cells, rows, columns or styles.

From BIFF3 on, some of the elements occur unchanged in every BIFF version. These elements are described in the following using a specific name for each element. In the description of the record structure the names are used to reference to these tables.

5.59.1 XF Substructures

- **XF_TYPE_PROT – XF type and cell protection (3 bits), BIFF3-BIFF8**

These 3 bits are part of a specific data byte.

Bit	Mask	Contents
0	01 _H	1 = Cell is locked
1	02 _H	1 = Formula is hidden
2	04 _H	0 = Cell XF; 1 = Style XF

- **XF_USED_ATTRIB – Attributes used from parent style XF (1 byte), BIFF3-BIFF8**

In this byte, each bit describes the validity of a specific attribute. In cell XFs a cleared bit means the attribute of the parent style XF is used, a set bit means the attribute of this XF is used. In style XFs a cleared bit means the attribute setting is valid, a set bit means the attribute should be ignored.

Bit	Mask	Contents
2	04 _H	Flag for number format
3	08 _H	Flag for font
4	10 _H	Flag for alignment, text wrap and rotation
5	20 _H	Flag for border lines
6	40 _H	Flag for background area style
7	80 _H	Flag for cell protection (cell locked and formula hidden)

- **XF_HOR_ALIGN – Horizontal alignment (3 bits), BIFF2-BIFF8**

The horizontal alignment consists of 3 bits and is part of a specific data byte.

Value	Horizontal alignment
00 _H	General
01 _H	Left
02 _H	Centered
03 _H	Right
04 _H	Filled
05 _H	Justified (BIFF3-BIFF8)
06 _H	Centered across selection (BIFF3-BIFF8)

- **XF_VERT_ALIGN – Vertical alignment (2/3 bits), BIFF4-BIFF8**

The vertical alignment consists of 2 bits (BIFF4) or 3 bits (BIFF5-BIFF8) and is part of a specific data byte. Vertical alignment is not available in BIFF2 and BIFF3.

Value	Vertical alignment
00 _H	Left
01 _H	Centered
02 _H	Right
03 _H	Justified (BIFF5-BIFF8X)
04 _H	Distributed (BIFF8X)

- **XF_ORIENTATION – Text orientation (2 bits), BIFF4-BIFF7**

In the BIFF versions BIFF4-BIFF7, text can be rotated in steps of 90-degrees or stacked. The orientation mode consists of 2 bits and is part of a specific data byte. In BIFF8 a rotation angle occurs instead of these flags.

Value	Text orientation
00 _H	Not rotated
01 _H	Letters are stacked top-to-bottom, but not rotated
02 _H	Text is rotated 90 degrees counterclockwise
03 _H	Text is rotated 90 degrees clockwise

- **XF_ROTATION – Text rotation angle (1 byte), BIFF8**

Value	Text rotation
0	Not rotated
1-90	1 to 90 degrees counterclockwise
91-180	1 to 90 degrees clockwise
255	Letters are stacked top-to-bottom, but not rotated

- **XF_BORDER_34 – Cell border style (4 bytes), BIFF3-BIFF4**

Cell borders contain a line style and a line color for each line of the border.

Bit	Mask	Contents
2-0	00000007 _H	Top line style (→2.7)
7-3	000000F8 _H	Index into PALETTE record for top line color (→5.42)
10-8	00000700 _H	Left line style
15-11	0000F800 _H	Index into PALETTE record for left line color
18-16	00070000 _H	Bottom line style
23-19	00F80000 _H	Index into PALETTE record for bottom line color
26-24	07000000 _H	Right line style
31-27	F8000000 _H	Index into PALETTE record for right line color

- **XF_AREA_34 – Cell background area style (2 bytes), BIFF3-BIFF4**

A cell background area style contains an area pattern and a foreground and background color.

Bit	Mask	Contents
5-0	003F _H	Fill pattern (→2.8)
10-6	07C0 _H	Index into PALETTE record for pattern foreground (→5.42)
15-11	F800 _H	Index into PALETTE record for pattern background

5.59.2 XF Record Contents

Record XF, BIFF2:

Offset	Size	Contents																					
0	1	Index to FONT record (→5.27)																					
1	1	Not used																					
2	1	<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>5-0</td><td>3F_H</td><td>Index to FORMAT record (→5.28)</td></tr> <tr> <td>6</td><td>40_H</td><td>1 = Cell is locked</td></tr> <tr> <td>7</td><td>80_H</td><td>1 = Formula is hidden</td></tr> </tbody> </table>	Bit	Mask	Contents	5-0	3F _H	Index to FORMAT record (→5.28)	6	40 _H	1 = Cell is locked	7	80 _H	1 = Formula is hidden									
Bit	Mask	Contents																					
5-0	3F _H	Index to FORMAT record (→5.28)																					
6	40 _H	1 = Cell is locked																					
7	80 _H	1 = Formula is hidden																					
3	1	<table border="1"> <thead> <tr> <th>Bit</th> <th>Mask</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>2-0</td><td>07_H</td><td>XF_HOR_ALIGN – Horizontal alignment (see above)</td></tr> <tr> <td>3</td><td>08_H</td><td>1 = Cell has left black border</td></tr> <tr> <td>4</td><td>10_H</td><td>1 = Cell has right black border</td></tr> <tr> <td>5</td><td>20_H</td><td>1 = Cell has top black border</td></tr> <tr> <td>6</td><td>40_H</td><td>1 = Cell has bottom black border</td></tr> <tr> <td>7</td><td>80_H</td><td>1 = Cell has shaded background</td></tr> </tbody> </table>	Bit	Mask	Contents	2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)	3	08 _H	1 = Cell has left black border	4	10 _H	1 = Cell has right black border	5	20 _H	1 = Cell has top black border	6	40 _H	1 = Cell has bottom black border	7	80 _H	1 = Cell has shaded background
Bit	Mask	Contents																					
2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)																					
3	08 _H	1 = Cell has left black border																					
4	10 _H	1 = Cell has right black border																					
5	20 _H	1 = Cell has top black border																					
6	40 _H	1 = Cell has bottom black border																					
7	80 _H	1 = Cell has shaded background																					

Record XF, BIFF3:

Offset	Size	Contents												
0	1	Index to FONT record (→5.27)												
1	1	Index to FORMAT record (→5.28)												
2	1	XF_TYPE_PROT – XF type and cell protection (see above)												
3	1	XF_USED_ATTRIB – Used attributes (see above)												
4	2	<table border="1"> <thead> <tr> <th>Bit</th><th>Mask</th><th>Contents</th></tr> </thead> <tbody> <tr> <td>2-0</td><td>0007_H</td><td>XF_HOR_ALIGN – Horizontal alignment (see above)</td></tr> <tr> <td>3</td><td>0008_H</td><td>1 = Text is wrapped at right border</td></tr> <tr> <td>15-4</td><td>FFF0_H</td><td>Index to parent style XF (always FFF_H in style XFs)</td></tr> </tbody> </table>	Bit	Mask	Contents	2-0	0007 _H	XF_HOR_ALIGN – Horizontal alignment (see above)	3	0008 _H	1 = Text is wrapped at right border	15-4	FFF0 _H	Index to parent style XF (always FFF _H in style XFs)
Bit	Mask	Contents												
2-0	0007 _H	XF_HOR_ALIGN – Horizontal alignment (see above)												
3	0008 _H	1 = Text is wrapped at right border												
15-4	FFF0 _H	Index to parent style XF (always FFF _H in style XFs)												
6	2	XF_AREA_34 – Cell background area (see above)												
8	4	XF_BORDER_34 – Cell border lines (see above)												

Record XF, BIFF4:

Offset	Size	Contents															
0	1	Index to FONT record (→5.27)															
1	1	Index to FORMAT record (→5.28)															
2	2	<table border="1"> <thead> <tr> <th>Bit</th><th>Mask</th><th>Contents</th></tr> </thead> <tbody> <tr> <td>2-0</td><td>0007_H</td><td>XF_TYPE_PROT – XF type, cell protection (see above)</td></tr> <tr> <td>15-4</td><td>FFF0_H</td><td>Index to parent style XF (always FFF_H in style XFs)</td></tr> </tbody> </table>	Bit	Mask	Contents	2-0	0007 _H	XF_TYPE_PROT – XF type, cell protection (see above)	15-4	FFF0 _H	Index to parent style XF (always FFF _H in style XFs)						
Bit	Mask	Contents															
2-0	0007 _H	XF_TYPE_PROT – XF type, cell protection (see above)															
15-4	FFF0 _H	Index to parent style XF (always FFF _H in style XFs)															
4	1	<table border="1"> <thead> <tr> <th>Bit</th><th>Mask</th><th>Contents</th></tr> </thead> <tbody> <tr> <td>2-0</td><td>07_H</td><td>XF_HOR_ALIGN – Horizontal alignment (see above)</td></tr> <tr> <td>3</td><td>08_H</td><td>1 = Text is wrapped at right border</td></tr> <tr> <td>5-4</td><td>30_H</td><td>XF_VERT_ALIGN – Vertical alignment (see above)</td></tr> <tr> <td>7-6</td><td>C0_H</td><td>XF_ORIENTATION – Text orientation (see above)</td></tr> </tbody> </table>	Bit	Mask	Contents	2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)	3	08 _H	1 = Text is wrapped at right border	5-4	30 _H	XF_VERT_ALIGN – Vertical alignment (see above)	7-6	C0 _H	XF_ORIENTATION – Text orientation (see above)
Bit	Mask	Contents															
2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)															
3	08 _H	1 = Text is wrapped at right border															
5-4	30 _H	XF_VERT_ALIGN – Vertical alignment (see above)															
7-6	C0 _H	XF_ORIENTATION – Text orientation (see above)															
5	1	XF_USED_ATTRIB – Used attributes (see above)															
6	2	XF_AREA_34 – Cell background area (see above)															
8	4	XF_BORDER_34 – Cell border lines (see above)															

5 Worksheet/Workbook Records

Record XF, BIFF5/BIFF7:

Offset	Size	Contents		
		Bit	Mask	Contents
0	2		0007 _H	Index to FONT record (→5.27)
2	2		FFF0 _H	Index to FORMAT record (→5.28)
4	2	Bit	Mask	Contents
		2-0	0007 _H	XF_TYPE_PROT – XF type, cell protection (see above)
		15-4	FFF0 _H	Index to parent style XF (always FFF _H in style XFs)
6	1	Bit	Mask	Contents
		2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)
		3	08 _H	1 = Text is wrapped at right border
		6-4	70 _H	XF_VERT_ALIGN – Vertical alignment (see above)
7	1	Bit	Mask	Contents
		1-0	03 _H	XF_ORIENTATION – Text orientation (see above)
		7-2	FC _H	XF_USED_ATTRIB – Used attributes (see above)
8	4	Cell border lines and background area:		
		Bit	Mask	Contents
		6-0	0000007F _H	Index into PALETTE for pattern foreground
		13-7	000003F8 _H	Index into PALETTE for pattern background
		21-16	003F0000 _H	Fill pattern (→2.8)
		24-22	01C00000 _H	Bottom line style (→2.7)
		31-25	FE000000 _H	Index into PALETTE for bottom line color
12	4	Bit	Mask	Contents
		2-0	00000007 _H	Top line style (→2.7)
		5-3	00000038 _H	Left line style
		8-6	000001C0 _H	Right line style
		15-9	0000FE00 _H	Index into PALETTE for top line color
		22-16	007F0000 _H	Index into PALETTE for left line color
		29-23	3F800000 _H	Index into PALETTE for right line color

Record XF, BIFF8:

Offset	Size	Contents		
		Bit	Mask	Contents
0	2			Index to FONT record (→5.27)
2	2			Index to FORMAT record (→5.28)
4	2	2-0	0007 _H	XF_TYPE_PROT – XF type, cell protection (see above)
		15-4	FFFO _H	Index to parent style XF (always FFF _H in style XFs)
6	1	2-0	07 _H	XF_HOR_ALIGN – Horizontal alignment (see above)
		3	08 _H	1 = Text is wrapped at right border
		6-4	70 _H	XF_VERT_ALIGN – Vertical alignment (see above)
7	1	XF_ROTATION: Text rotation angle (see above)		
8	1	3-0	0F _H	Indent level
		4	10 _H	1 = Shrink content to fit into cell
9	1	7-2	FC _H	XF_USED_ATTRIB – Used attributes (see above)
10	4	Cell border lines and background area:		
		Bit	Mask	Contents
		3-0	0000000F _H	Left line style (→2.7)
		7-4	000000F0 _H	Right line style
		11-8	00000F00 _H	Top line style
		15-12	0000F000 _H	Bottom line style
		22-16	007F0000 _H	Index into PALETTE for left line color
		29-23	3F800000 _H	Index into PALETTE for right line color
		30	40000000 _H	1 = Diagonal line from top left to right bottom
		31	80000000 _H	1 = Diagonal line from bottom left to right top
14	4	6-0	0000007F _H	Index into PALETTE for top line color
		13-7	00003F80 _H	Index into PALETTE for bottom line color
		20-14	001FC000 _H	Index into PALETTE for diagonal line color
		24-21	01E00000 _H	Diagonal line style (→2.7)
		31-26	FC000000 _H	Fill pattern (→2.8)
18	2	6-0	007F _H	Index into PALETTE for pattern foreground
		13-7	3F80 _H	Index into PALETTE for pattern background

6 Drawing Objects, Escher Layer

2do

7 Charts

2do

8 PivotTables

2do

9 Change Tracking

2do