



Suzaku

## CHANGE RECORD PAGE (1 of 2)

## DESCRIPTION OF THE SUZAKU CALIBRATION FILES

Version 1.2

DATE June 12, 2006

DOCUMENT TITLE			
Requirements Document		DOCUMENT DATE:	
ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Version 0.8	6 June 2005	all	First release
Version 0.9	15 July 2005	General, HXD, XRS	Update with HXD and XRS files
Version 0.92	10 Jan 2005	All	Update with HXD
Version 0.94	1 Apr 2005	All	Update in preparation of CALDB 1st release
Version 0.95	11 April 2005	General HXD XIS	Minor fixes add reflect and bacprof
Version 1	12 April 2005		First document release
Version 1.1 & 1.2	26 May 2006 & 12 Jun 2006	XIS and XRT	XIS contamination ; XRT PSF & Effective area

Prepared by:

Lorella Angelini (HEASARC), Ilana Harrus (Suzaku/GOF) &amp; Ken Ebisawa (ISAS)

## Table of Contents

<b>1</b>	<b>Introduction.....</b>	<b>8</b>
1.1	Scope.....	8
1.2	References.....	8
1.3	Acronyms.....	9
<b>2</b>	<b>Suzaku Calibration File Set.....</b>	<b>10</b>
2.1	File Naming Convention.....	10
2.2	Suzaku Datatypes.....	10
<b>3</b>	<b>Suzaku Files General Description.....</b>	<b>12</b>
3.1	Mandatory Keywords.....	12
<b>4</b>	<b>HXD files format.....</b>	<b>16</b>
4.1	Telescope Definition File.....	16
4.1.1	File Name.....	16
4.1.2	Description.....	16
4.1.3	File Format.....	16
4.1.4	Primary Header Keywords.....	17
4.1.5	Extension 1 - Header Keywords.....	17
4.2	Linearization PIN Calibration File.....	18
4.2.1	File Name.....	18
4.2.2	Description.....	18
4.2.3	File Format.....	18
4.2.4	Primary Header Keywords.....	19
4.2.5	Extension 1 - Header Keywords.....	19
4.2.6	Extension 2 - Header Keywords.....	19
4.3	Linearization GSO Calibration File.....	20
4.3.1	File Name.....	20
4.3.2	Description.....	20
4.3.3	File Format.....	20
4.3.4	Primary Header Keywords.....	21
4.3.5	Extension 1 - Header Keywords.....	21
4.3.6	Extension 2 - Header Keywords.....	22
4.4	Rebin setting Calibration File.....	22
4.4.1	File Name.....	22
4.4.2	Description.....	22
4.4.3	File Format.....	22
4.4.4	Primary Header Keywords.....	23
4.4.5	Extension 1 - Header Keywords.....	23
4.5	Grade selection GSO Calibration File.....	23
4.5.1	File Name.....	23
4.5.2	Description.....	24
4.5.3	File Format.....	24
4.5.4	Primary Header Keywords.....	24
4.5.5	Extension 1 - Header Keywords.....	24
4.6	GSO & PIN Ancillary library Calibration File.....	25
4.6.1	File Name.....	25
4.6.2	Description.....	25
4.6.3	File Format.....	25
4.6.4	Primary Header Keywords.....	25
4.6.5	Extension 1 - Header Keywords.....	26
4.6.6	Extension 2 - Header Keywords.....	26
4.7	Threshold PIN Calibration File.....	27
4.7.1	File Name.....	27
4.7.2	Description.....	27
4.7.3	File Format.....	27
4.7.4	Primary Header Keywords.....	27
4.7.5	Extension 1 - Header Keywords.....	27
4.8	GSO gain history Calibration File.....	28
4.8.1	File Name.....	28
4.8.2	Description.....	28
4.8.3	File Format.....	28
4.8.4	Primary Header Keywords.....	29
4.8.5	Extension 1 - Header Keywords.....	30
4.8.6	Extension 2 - Header Keywords.....	30
4.8.7	Extension 3 - Header Keywords.....	31
4.9	PIN Gain History Calibration File.....	32
4.9.1	File Name.....	32
4.9.2	Description.....	32
4.9.3	File Format.....	32
4.9.4	Primary Header Keywords.....	32
4.9.5	Extension 1 - Header Keywords.....	32
4.10	Response Matrices.....	33
4.10.1	File Name.....	33
4.10.2	Description.....	33
4.10.3	File Format.....	34
4.10.4	Primary Header Keywords.....	34
4.10.5	Extension 1 - Header Keywords.....	34
4.10.6	Extension 2 - Header Keywords.....	35
<b>5</b>	<b>XIS files format.....</b>	<b>36</b>
5.1	Telescope Definition File.....	36
5.1.1	File Name.....	36
5.1.2	Description.....	37
5.1.3	File Format.....	37
5.1.4	Primary Header Keywords.....	37
5.2	XIS Bad columns Calibration File.....	38
5.2.1	File Name.....	38
5.2.2	Description.....	38
5.2.3	File Format.....	38
5.2.4	Primary Header Keywords.....	38
5.2.5	Extension 1 - Header Keywords.....	38
5.3	XIS Calibration sources Mask File.....	39
5.3.1	File Name.....	39
5.3.2	Description.....	39
5.3.3	File Format.....	39
5.3.4	Primary Header Keywords.....	39
5.4	XIS CTI Calibration File.....	40
5.4.1	File Name.....	40
5.4.2	Description.....	40
5.4.3	File Format.....	40
5.4.4	Primary Header Keywords.....	43
5.4.5	Extension 1 to 7 - Header Keywords.....	43
5.5	XIS quantum efficiency Calibration File.....	44
5.5.1	File Name.....	44
5.5.2	Description.....	44
5.5.3	File Format.....	44
5.5.4	Primary Header Keywords.....	46

5.5.5	Extension 1 to 4 - Header Keywords	46
5.6	XIS parameters to build the RMF Calibration File	47
5.6.1	File Name	47
5.6.2	Description	47
5.6.3	File Format	47
5.6.4	Primary Header Keywords	48
5.6.5	Extension 1 - Header Keywords	48
5.7	XIS Micro code id Calibration File	49
5.7.1	File Name	49
5.7.2	Description	49
5.7.3	File Format	49
5.7.4	Primary Header Keywords	50
5.7.5	Extension 1 - Header Keywords	50
5.8	XIS Response Matrices	50
5.8.1	File Name	50
5.8.2	Description	51
5.8.3	File Format	51
5.8.4	Primary Header Keywords	52
5.8.5	Extension 1 - Header Keywords	52
5.8.6	Extension 2 - Header Keywords	53
5.9	Ancillary Response File	54
5.9.1	File name	54
5.9.2	Description	54
5.9.3	File Format	54
5.9.4	Primary Header Keywords	54
5.9.5	Extension 1 - Header Keywords	54
5.10	XIS contamination file	55
5.10.1	File Name	55
5.10.2	Description	55
5.10.3	File Format	56
5.10.4	Primary Header Keywords	56
5.10.5	Extension 1 - Header Keywords	56
5.10.6	Extension 2 - Header Keywords	57
<b>6</b>	<b>XRS files format</b>	<b>57</b>
6.1	Telescope Definition File	57
6.1.1	File Name	57
6.1.2	Description	58
6.1.3	File Format	58
6.1.4	Primary Header Keywords	58
6.1.5	Extension 1 - Header Keywords	59
6.2	Bad Pixel Table File	59
6.2.1	File Name	59
6.2.2	Description	59
6.2.3	File Format	60
6.2.4	Primary Header Keywords	60
6.2.5	Extension 1 - Header Keywords	60
6.3	Blocking Filter Calibration File	61
6.3.1	File Name	61
6.3.2	Description	61
6.3.3	File Format	61
6.3.4	Primary Header Keywords	61
6.3.5	Extension 1 - Header Keywords	61
6.4	Filter Transmission Calibration Files	62

6.4.1	File Name	62
6.4.2	Description	62
6.4.3	File Format	62
6.4.4	Primary Header Keywords	63
6.4.5	Extension 1 - Header Keywords	63
6.5	Gate Valve Calibration File	64
6.5.1	File Name	64
6.5.2	Description	64
6.5.3	File Format	64
6.5.4	Primary Header Keywords	64
6.5.5	Extension 1 - Header Keywords	64
6.6	Quantum Efficiency Calibration File	65
6.6.1	File Name	65
6.6.2	Description	65
6.6.3	File Format	65
6.6.4	Primary Header Keywords	65
6.6.5	Extension 1 - Header Keywords	66
6.7	Gain Calibration File	66
6.7.1	File Name	66
6.7.2	Description	66
6.7.3	File Format	67
6.7.4	Primary Header Keywords	67
6.7.5	Extension 1 - Header Keywords	67
6.8	Response Matrices	68
6.8.1	File Name	68
6.8.2	Description	68
6.8.3	File Format	69
6.8.4	Primary Header Keywords	69
6.8.5	Extension 1 - Header Keywords	69
6.8.6	Extension 1 - Header Keywords	70
<b>7</b>	<b>XRT files format</b>	<b>71</b>
7.1	Mirror Geometry Calibration File	71
7.1.1	File Name	71
7.1.2	Description	71
7.1.3	File Format	71
7.1.4	Primary Header Keywords	72
7.1.5	Extension 1 - Header Keywords	72
7.1.6	Extension 2 - Header Keywords	73
7.2	Pre-Collimator Geometry Calibration File	74
7.2.1	File Name	74
7.2.2	Description	74
7.2.3	File Format	74
7.2.4	Primary Header Keywords	75
7.2.5	Extension 1 - Header Keywords	75
7.3	Thermal Shield Transmission Calibration File	76
7.3.1	File Name	76
7.3.2	Description	76
7.3.3	File Format	76
7.3.4	Primary Header Keywords	76
7.3.5	Extension 1 - Header Keywords	77
7.4	Mirror Reflectivity Calibration File	77
7.4.1	File Name	77
7.4.2	Description	77

7.4.3	Primary Header Keywords.....	78
7.4.4	Extension 1 - Header Keywords.....	78
7.4.5	Extension 2 - Header Keywords.....	79
7.4.6	Extension 3 - Header Keywords.....	80
7.5	Backside profile Calibration File.....	80
7.5.1	File Name.....	80
7.5.2	Description.....	81
7.5.3	Primary Header Keywords.....	81
7.5.4	Extension 1 - Header Keywords.....	81
7.6	Effective area.....	82
7.6.1	File Name.....	82
7.6.2	Description.....	82
7.6.3	File Format.....	82
7.6.4	Primary Header Keywords.....	83
7.6.5	Extension 1 - Header Keywords.....	83
7.6.6	Extension 2 - Header Keywords.....	84
7.7	PSF.....	84
7.7.1	File Name.....	84
7.7.2	Description.....	84
7.7.3	File Format.....	85
7.7.4	Primary Header Keywords.....	85
7.7.5	Extension 1 - Header Keywords.....	85

## 1 Introduction

This document describes the format of Suzaku (formerly Astro-E2) Calibration Files and their organization into CALibration DataBase (CALDB). CALDB includes the pre-launch results obtained from the analysis of the ground calibration data and also those derived from calibration observations taken in flight during the lifetime of the mission. The results are stored in the OGIP CALDB structure as FITS file following whenever possible standard OGIP format layout. These files are recorded in CALDB for archival purposes and they are used in the Suzaku processing software. Specifically the CALDB files are used in the Suzaku pipeline to create Level 1 and Level 2 science files and in the interactive analysis.

The Suzaku calibration files are produced by the instrument teams and collected at ISAS. These files are delivered to the Suzaku/GOF at GSFC that checks the validity of the files, their formats and the mandatory CALDB keywords. Once the files have been checked and amended, a CALDB index is created. These files are then delivered from the Suzaku/GOF, via an automatic procedure, to the HEASARC that archives and distributes the data.

### 1.1 Scope

During the course of the Suzaku mission the CALDB shall provide:

A way to store and archive the calibration data;

A naming convention and header structure for the calibration files;

An index for the software that access the calibration database using FITS header keywords;

A traceable history of the calibration data by maintaining the history of versions.

### 1.2 References

[1] - *BCF & CPF Calibration File Guidelines* - OGIP Calibration Memo CAL/GEN/92-003

[2] - *HFWG Recommendation R8* -1994 February 02

[3] - *Required and Recommended FITS keywords for Calibration Files* -OGIP Calibration Memo CAL/GEN/92-011

### 1.3 Acronyms

ARF	Ancillary Response File
BCF	Basic Calibration File
CALDB	Calibration Database
CCD	Charge Coupled Device
CIF	Calibration File
CPF	Calibration Product File
CTI	Charge Transfer Inefficiency
EEF	Encircled Energy Fraction
FITS	Flexible Image Transport System
GOF	Guest Observer Facility
GSFC	Goddard Space Flight Center
GSO	Gadolinium Silicate
HDU	Header Data Unit
HEASARC	High Energy Astrophysics Science Archive Research Center
HFWG	High Energy FITS Working Group
HXD	Hard X-ray Detector
ISAS	Institute of Space and Astronomical Science
OGIP	Office of the Guest Investigator Programs
PHA	Pulse Height Amplitude
PI	Pulse Invariant
PIN	Positive Intrinsic Negative
PSF	Point Spread Function
QE	Quantum Efficiency
RMF	Redistribution Matrix File
TRN	
XIS	X-ray Imaging spectrometers
XRS	X-ray spectrometers
XRT	X-Ray Telescope

## 2 Suzaku Calibration File Set

The chapter lists the naming convention for the CALDB files and the different calibration type products stored in CALDB.

### 2.1 File Naming Convention

The filename convention is the following:

```
<mi>_<int>_<datatype>_<date>].ext
```

where:

**mi** is a 2 digit string that identifies the mission. The mission identifier string is set to 'ae' named after the initial of Astro-E2. Despite the post launch name change to Suzaku, the filename in CALDB and in the archive retain in the file identification the initial of the original mission name;

**int** is a 3 or 4 digit string identifying the instrument. The 3 digits string is for the detecting instruments (HXD, XIS and XRS), 4 digits string is used in files carry information on the telescopes. The instrument identifier is set as follows: 'hxd' for the HXD; 'xrs' for the XRS; 'xi0', 'xi1', 'xi2' and 'xi3' for the 4 XIS units or 'xis' for files that applies to all XIS units. These strings are used in the filenames of CALDB and science files. For the telescopes the string identifiers are : 'xrt' for all telescopes I or S; 'xrts' for the XRT-S telescope; 'xrti' for the XRT-I telescope; 'xrt1', 'xrt2', 'xrt3', 'xrt4' for the 4 XRT-I telescope units. These telescope strings are only used in the filename of CALDB files.

**datatype** is the calibration data type identifier. The string should describe the file content unambiguously within 8 characters long. Underscores or mathematical symbols are not allowed. Longer strings may be considered on case by case basis (up to 10), but they are strongly discouraged;

**date** is a string that records the date when the files were released. The date is written as YYYYMMDD.

**ext** is set to 'fits' for all files with the following exceptions: 'rmf' or 'rsp' is used for the redistribution matrix and 'arf' is used for the ancillary response files.

### 2.2 Suzaku Datatypes

Table 2.1 contains a summary of all the different type of calibration files

<i>Datatype</i>	<i>Cal directory</i>	<i>Used in pipeline</i>	<i>Description</i>
<b>HXD</b>			
teldef		bcf yes	Telescope definition file
gsolin/pinlin		bcf yes	Use in the conversion from PHA to PI for the WELL_GSO and WELL_PIN
wampht		bcf yes	Setting to rebin the PHA spectra for the WAM_ANTI
gsopsd		bcf yes	Selection on the pulse slope discriminator for the WELL_GSO
gsoart/pinart		bcf yes	Library of effective areas sampled for different parameters used to create the ARF for the WELL_GSO and WELL_PIN
pintrh		bcf yes	Threshold for PI for the WELL_PIN
gsogh/pinghf		bcf yes	Gain History file for the WELL_GSO and WELL_PIN

HXD			
gsohxnom/pinhxnom	cpf	no	Full response matrices with the HXD nominal pointing for the WELL_GSO and WELL_PIN
gsoxinom/pinxinom	cpf	no	Full response matrices with the XIS nominal pointing for the WELL_GSO and WELL_PIN
XIS			
teldef	bcf	yes	Telescope definition file. One file per XIS unit.
badcolumn	bcf	yes	XIS bad columns. One file per XIS unit.
calmask	bcf	yes	Image marking the position of the calibration sources. One file per XIS unit.
makepi	bcf	yes	Charge transfer inefficiency parameters. One file per XIS unit.
quanteff	bcf	yes	Quantum efficiency. One file per XIS unit.
rmfparam	bcf	yes	Instrumental parameters to build rmf. One file per XIS unit.
uocode	bcf	no	Bits Code assigned for a mode. One file per XIS unit.
rmf*	cpf		Response matrices. One file per XIS unit.
hxdnom	cpf		ARF with a HXD nominal pointing. One file per XIS unit.
onaxis	cpf		ARFwith an on-axis XIS nominal pointing. One file per XIS unit.
contami	bcf		Coefficients of the curve of growth that describes the optical blocking filter contamination
XRS			
teldef	bcf		Telescope definition file
bad pixel	bcf		Table of dead/hot pixels apply to data and table dead/hot loaded on board
blckfilt	bcf		Blocking Filter Transmission
fw3bn/fw5nn/ fw4bc /fw6nc	bcf		Filter transmission for the filters in the filter wheel located in from of the XRS
gatevalve	bcf		Transmission of the gate valve
qe	bcf		Quantum Efficiency
gain	bcf		Coefficient to calculate the gain.
rmf	cpf		Response matrix. One for each pixel of the XRS
XRT			
mirror	bcf	no	Mirror geometry
pcol	bcf	no	Pre-collimator geometry
shield	bcf	no	Thermal shield transmission

reflect	bcf	no	Mirror reflectivity
backprof	bcf	no	Backside mirror profile
effearea	bcf		Effective area
psf	bcf		Library of psf

Table 2.1 -Datatypes and short description of Suzaku files

\*The 'rmf' is the extension for the XIS response. The datatypes is a null string.

### 3 Suzaku Files General Description

All Suzaku calibration files are FITS files. Keywords required by FITS OGIP standards and listed in this chapter are described in documents [1], [2] and [3] (see references in Section 1). Chapters 4, 5, 6, and 7 give the exact strings used in the CALDB keywords for the HXD, XIS, XRS and XRT respectively and well as a description of different file FITS format. Although the XRS stopped operating within a month of the start-up of the mission, the pre-launch calibration files are archived in CALDB.

#### 3.1 Mandatory Keywords

Table 3.1 lists the mandatory keywords added to the primary and to the headers of all extensions of the Calibration FITS files. The text for the comment column is shown as **it should appear in the files**. Remarks on specific comments are added *in italics*.

Keyword name	Keyword value	Comment (as it should appear in the file)
TELESCOP	'SUZAKU'	/Telescope (mission) name
INSTRUME	<instrument>	/Instrument Name
DETNAM	<detector name>	/Detector name <i>Applicable only for the HXD and XRS</i>
FILTER	<filter>	/Filter keyword <i>Applicable only to the XRS and omitted from the primary header</i>
DATE	YYYY-MM-DDThh:mm:ss	/Creation Date <i>This keyword is omitted from empty primary headers.</i>
CHECKSUM	<up to date checksum>	/HDU checksum updated <date>
DATASUM	<up to date datasum>	/Data unit checksum updated <date>

Table 3.1 – Suzaku mandatory header keywords

Table 3.2 lists the additional mandatory keywords common to all table headers. Each CALDB keyword has different values for different Calibration Files. The values for the CALDB and the EXTNAME keywords are specified for each *datatype* in the chapter dedicated to each of the instruments.

Keyword name	Keyword value	Comment (as it should appear in the file)
--------------	---------------	---

EXTNAME	<extension name>	/Name of the binary table extension <i>This keyword is omitted for data in the primary header</i>
ORIGIN	<organization name>	/Source of FITS file
CREATOR	< task name and version number>	/Creator
FILENAME	<file name>	/File name
VERSION	<version number>	/Extension version number
<b>CALDB Keywords</b>		
CCLxxxx	OGIP-class of calibration file	/Dataset is a Calibration Product File /Dataset is a Basic Calibration File <i>The comment depends on the datatype see sect 2.1</i>
CDTPxxxx	<datatype code>	/Calibration file contains data
CCNMxxxx	<extension codename>	/Type of Calibration data
CDESxxxx	<descriptive string>	/Description
CVSDxxxx	<start valid data>	/UTC date when file should first be used
CVSTxxxx	<start valid time>	/UTC time when file should first be used

Table 3.2 - Table Headers mandatory keywords

Table 3.3 and 3.4 list header keywords required in specific cases. These keywords are specified, when necessary, for each datatype. The keywords content is described in the chapters dedicated to each of the instruments.

Note that the "CBDnxxx" keyword **should be used to differentiate otherwise identical extensions in a file**. The first CBD keyword should be named CBD10001, the second CBD20001, etc... All CBD keywords should follow the syntax "KEYWORD (SELECTION)" where "keyword" is the quantity on which a selection is done.

For example, in order to distinguish between two extensions in the XRT-I reflectivity table FITS file, we used:

CBD10001 =ENERG(0.1-12.0)' and CBD20001=POS(FRONT) for the extension describing the FRONT mirror and CBD10001 = 'ENERG(0.1-12.0)' and CBD20001=POS(BACK) for the extension describing the BACK mirror.

The keywords in the table 3.4 should be present if the binary table contains columns related to time.

Keyword name	Keyword value	Comment (as it should appear in the file)
CBDnxxxx	Array describing parameter limitations of the dataset	/Parameter boundaries
TDIMnnn	Number of elements & Ordering of n-d array	/Array dimensions
HDUCLASS	'OGIP'	/Format conforms to OGIP standards <i>(Only when applicable)</i>
HDUDOC	<document number>	/Document describing the format <i>(Only when applicable)</i>
HDUCLASn	<character string to classify the extension	/Specific to the type

		<i>(Only when applicable)</i>
H DUVERS <sub>n</sub>	<string giving the format version>	/Version of file format <i>(Only when applicable)</i>

Table 3.3 – Table Headers keywords required in specific cases

Keyword name	Keyword value	Comment (as it should appear in the file)
TIMESYS	TT	/Time system
MJDREFI	51544	/Reference MJD, Integer part
MJDREFF	0.00074287037037037	/Reference MJD, fractional part
CLOCKAPP	T	/If clock corrections are applied (F/T)

Table 3.4 – Table Headers keywords required to specify time

The content for the keywords INSTRUME, DETNAM and FILTER are listed in the following tables. These strings are also used in the science data files.

Keyword Name	Keyword String	Explanation (not FITS comment)
<b>HXD</b>		
INSTRUME	HXD	The INSTRUME keyword is set to HXD in all calibration and science files. The DETNAM keyword distinguishes between the different sub-units that form the HXD. These are GSO, PIN for the WELL and ANTI for the WAM.
DETNAM	WELL	The string WELL is used in files that are applicable for the GSO and PIN data
	WELL_GSO	The string WELL_GSO is used in files that are applicable only for the GSO data
	WELL_PIN	The string WELL_PIN is used in files that are applicable only for the PIN data
DETNAM	WAM_ANTI	The string WAM_ANTI is used in files that record data from the WAM sub-units

Keyword Name	Keyword String	Explanation (not FITS comment)
<b>XIS</b>		
INSTRUME	XIS0	The XIS instrument is composite of four separate detectors units and they are numbered starting from 0. The calibration files as for the science data have defined a single keyword INSTRUME to identify the unit. The string XIS0 is used in files related to the XIS unit 0.

	XIS1	The string XIS1 is used in files related to the XIS unit 1.
	XIS2	The string XIS2 is used in files related to the XIS unit 2.
	XIS3	The string XIS3 is used in files related to the XIS unit 3.
	XIS	The string XIS is used in files applicable to all XIS units
<b>Keyword Name</b>	<b>Keyword String</b>	<b>Explanation (not FITS comment)</b>
<b>XRS</b>		
INSTRUME	XRS	The string XRS is in CALDB or science files related to the calorimeter.
DETNAM	PIXnn	This string PIXnn is in CALDB files for specific pixel in the array, where nn is a two digits number ranging from 00 to 31. If the keyword DETNAM is missing, the calibration file is applicable to all pixels.
The XRS has a filter wheel mounted above the detector with 6 filter positions each carrying a different filter. The FILTER keyword records a string to identify the different filters on the filter wheel.		
FILTER	OPEN	The string OPEN is used when the filter is in the open position, the position 1 on the filter wheel.
	OPEN_CAL	The string OPEN_CAL is used when the filter is in the open position with the calibration source, the position 2 on the filter wheel.
	BE300	The string BE300 is used when the filter is the beryllium 300 microns, the position 3 on the filter wheel.
	BE300_CAL	The string BE300_CAL is used when the filter is the beryllium 300 microns with the calibration sources, the position 4 on the filter wheel.
	ND10P	The string ND10P is used when the filter is on the neutral density, the position 5 on the filter wheel.
	ND10P_CAL	The string ND10P_CAL is used when the filter is on the neutral density, the position 6 on the filter wheel.
The XRS optical blocking filter is not mounted on the filter wheel but all science data are screened by this filter.		
FILTER	BLCKFILT	The string BLCKFILT is in CALDB files related to the blocking filter.
The XRS gate valve is above the detector and will open to allow science observations. It can not be closed down.		
FILTER	GATEVALV	The string GATEVALV is used in CALDB files related to the gate valve.
<b>Keyword Name</b>	<b>Keyword String</b>	<b>Explanation (not FITS comment)</b>
<b>XRT</b>		
There are two telescope types on Suzaku with different focal length. One is used in conjunction with the XRS and the others are used in conjunction with the XIS detector units.		
INSTRUME	XRT	The string identifies CALDB files common to XRT-S and XRT-I.
	XRT-S	The string XRT-S identifies the telescope used with the XRS.
	XRT-I	The string XRT-I identifies the telescope used with any of the XIS units and is used in files that applicable to all XRT-I telescopes units.
	XRT-I0	The string XRT-I0 identifies the telescope unit 0 used in with the XIS0.

	XRT-I1	The string XRT-I1 identifies the telescope unit 0 used in with the XIS1.
	XRT-I2	The string XRT-I2 identifies the telescope unit 0 used in with the XIS2.
	XRT-I3	The string XRT-I3 identifies the telescope unit 0 used in with the XIS3.

Table 3.5 – Suzaku table of instrument, filter and detector name allowed values

## 4 HXD files format

### 4.1 Telescope Definition File

#### 4.1.1 File Name

ae\_hxd\_teldef\_YYYYMMDD.fits

#### 4.1.2 Description

The HXD data reduction software requires as input the Telescope Definition file (teldef). This is a FITS file containing in the primary HDU a set of keywords describing the telescope and instrument characteristics, the coordinate systems definition and the transformations between them and a first extension containing the alignment measured on ground for the different detectors. The HXD is not an imaging instrument but the coordinates systems is defined in term of detectors. There are four sets of coordinates defined for the Suzaku HXD: raw (RAW), detector (DET), focal (FOC) and sky (SKY). The RAW coordinates although listed in the teldef file they are not in use. The DET coordinates correspond to the 16 GSO and 64 PIN detectors. They are numbered starting both from 0 (PIN 0-63, GSO 0-15). The FOC coordinates are the focal plane coordinates where the XRS and XIS are also aligned and finally the SKY are mapped into the sky and provide the RA and Dec for each pixel.

The keyword NCOORDS set to 4 gives the total coordinate systems in use and the different coordinate systems are specified in the keywords COORDn (n=0,3). For each set of coordinates there are several keywords describing how the pixel are numbered as well as the value for the coefficient that are used in the transformation from the one system to another.

#### 4.1.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	HXD_ALIGNMENT	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	DETECTOR	%A	-
	INTX	E	arcmin
	INTY	E	arcmin

Table 4.1 – Telescope definition Calibration File Format



#### 4.1.4 Primary Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Below are listed specific settings of some of the CALDB keywords and others relevant to this file.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'TELDEF'	/Type of calibration data
CDTP0001	'DATA'	/Calibration file contains data
CBD10001	'FORMAT_VERSION(1)'	/Format version of Suzaku teldef file
CVSD0001	'YYYY-MM-DD'	/UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	/UTC time when calibration should first be used
CDES0001	'TELESCOPE DEFINITION FILE'	/Description

Table 4.2 - Telescope Description File Primary Header Keywords

#### 4.1.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment (as it should appear in the file)
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'HXD_ALIGNMENT'	/Type of calibration data
CDTP0001	'DATA'	/Calibration file contains data
CVSD0001	'YYYY-MM-DD'	/UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	/UTC time when calibration should first be used
CDES0001	'HXD alignment table'	/Description
<b>Teldef Files Keywords</b>		

EXTNAME	'HXD_ALIGNMENT'	Name of the binary table extension
<b>Table 4.3 - Teldef Calibration Files Extension 1 Keywords</b>		

Table 4.3 - Teldef Calibration Files Extension 1 Keywords

## 4.2 Linearization PIN Calibration File

### 4.2.1 File Name

ae\_hxd\_pinlin\_YYYYMMDD.fits

### 4.2.2 Description

This file contains information on the ADC linearization for the WELL\_PIN detector on the HXD. The file format consists of an empty primary header with two binary table extensions.

### 4.2.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	ADCINL	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	UNIT_ID	B	chan
	PHA_PIN0	I	chan
	AE_PI_PIN0	D	chan
	PHA_PIN1	I	chan
	AE_PI_PIN1	D	chan
	PHA_PIN2	I	chan
	AE_PI_PIN2	D	chan
	PHA_PIN3	I	chan
AE_PI_PIN3		chan	
2	BINTABLE	GAIN	
	UNIT_ID	B	-
	PIN0_GAIN	D	-
	PIN0_OFFSET	D	-
	PIN1_GAIN	D	-
	PIN1_OFFSET	D	-
	PIN2_GAIN	D	-

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
	PIN2_OFFSET	D	-
	PIN3_GAIN	D	-
	PIN3_OFFSET	D	-

Table 4.3 – Linearization PIN Calibration Files Format

**4.2.4 Primary Header Keywords**

All header keywords of Table 3.2 and applicable to this instrument are mandatory.

**4.2.5 Extension 1 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ADCINL'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Integrated non linearity for PIN ADC'	'Description
<b>Linearization Keywords</b>		
EXTNAME	'ADCINL'	'Name of the binary table extension
DETNAM	'WELL_PIN'	'Detector name

Table 4.4 – Linearization PIN Calibration Files Extension 1 Keywords

**4.2.6 Extension 2 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment

Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'GAIN'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Gain factor for each PIN diode'	'Description
<b>Linearization Keywords</b>		
EXTNAME	'GAIN'	'Name of the binary table extension
DETNAM	'WELL_PIN'	'Detector name

Table 4.5 – Linearization PIN Calibration Files Extension 2 Keywords

**4.3 Linearization GSO Calibration File**

**4.3.1 File Name**

ae\_hxd\_gsolin\_YYYYMMDD.fits

**4.3.2 Description**

This file contains information on the linearization for the WELL\_GSO detector on the HXD. The file format consists of an empty primary header with two binary table extensions.

**4.3.3 File Format**

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
0	PRIMARY		
1	BINTABLE	ADCDNL	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	UNIT_ID	B	-
	PHA_SLOW	I	chan
	ADC_SLOW_WIDTH	D	chan
	ADC_SLOW_START	D	chan
	PHA_FAST	I	chan
	ADC_FAST_WIDTH	D	chan

Extension N.	Type	Ext. Name	
	ADC_FAST_START	D	chan
2	BINTABLE	ADCINL	
	UNIT_ID	B	-
	ADC_PI_SLOW	D	chan
	AE_PI_SLOW	D	chan
	ADC_PI_FAST	D	chan
	AE_PI_FAST	D	chan

Table 4.6 – Linearization GSO Calibration Files Format

#### 4.3.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

#### 4.3.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ADCDNL'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Differential Non Linearity of SLOW and FAST ADC'	'Description
<b>Linearization Keywords</b>		
EXTNAME	'ADCDNL'	'Name of the binary table extension
DETNAM	'WELL_GSO'	'Detector name

Table 4.7 – Linearization GSO Calibration Files Extension 1 Keywords

#### 4.3.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ADCINL'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Integrated Non Linearity of SLOW and FAST ADC'	'Description
<b>Linearization Keywords</b>		
EXTNAME	'ADCINL'	'Name of the binary table extension
DETNAM	'WELL_GSO'	'Detector name

Table 4.8 – Linearization GSO Calibration Files Extension 2 Keywords

#### 4.4 Rebin setting Calibration File

##### 4.4.1 File Name

ae\_hxd\_wamphr\_YYYYMMDD.fits

##### 4.4.2 Description

This file contains information for setting the rebin of PHA spectrum for the WAM\_ANTI detector on the HXD. The file format consists of an empty primary header with one binary table extensions.

##### 4.4.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	TRN_PH	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	TABLE_ID	B	-

Extension N.	Type	Ext. Name	
	TRN_BIN<ij>	B	-
	ADD_FLG<j>	X	-

Table 4.9 – Rebin Calibration Files Format

Where <ij> index the column TRN\_BIN from 0-6 and <j> index the column ADD\_FLG from 0-53.

#### 4.4.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

#### 4.4.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'TRNPHTBL'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'REBIN settings for WAM PHA spectrum'	Description
<b>Rebin Files Keywords</b>		
EXTNAME	'THR_PH'	Name of the binary table extension
DETNAM	'WAM_ANTI'	Detector name

Table 4.10 – Rebin Calibration Files Extension 1 Keyword

### 4.5 Grade selection GSO Calibration File

#### 4.5.1 File Name

ae\_hxd\_gsopds\_YYYYMMDD.fits

#### 4.5.2 Description

This file contains information on the PSD (pulse shape discriminator) selection criteria for the WELL\_GSO detector on the HXD. The file format consists of an empty primary header with two binary table extensions.

#### 4.5.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	ADCDNL	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	UNIT_ID	B	-
	RPL_F	D	chan
	RPL_S_CEN	D	chan
	RPL_S_UP	D	chan
	RPL_S_LOW	D	chan

Table 4.11 – Selection criteria Calibration Files Format

#### 4.5.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

#### 4.5.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'PSDSEL'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'PSD selection criteria in hxdgrade'	Description

Gain Files Keywords		
EXTNAME	'PSDSEL'	Name of the binary table extension
DETNAM	'WELL_GSO'	Detector name

Table 4.12 – Selection Criteria Calibration Files Extension 1 Keywords

#### 4.6 GSO & PIN Ancillary library Calibration File

##### 4.6.1 File Name

ae\_hxd\_gsoart\_YYYYMMDD.fits & ae\_hxd\_pinart\_YYYYMMDD.fits

##### 4.6.2 Description

These files contain a library of effective area as function of angle from the optical axis and they are used in software to generate the instrument response. The files are for the GSO and PIN detector on the HXD instrument. They have an identical format that consists in a empty primary header and two binary extensions. The first extension contains two columns one is the angle from the optical axis and the second contains an array of effective area for each of the channel. The second extension contains the energy boundaries of each channel.

##### 4.6.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	ARFMATRIX	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ANGLE	D	arcmin
	SPECRESP	512D	cm**2
2	BINTABLE	ART_ENERGIES	
	CHANNEL	I	chan
	E_MIN	D	keV
	E_MAX	D	keV

Table 4.13 – Arf library Calibration Files Format

##### 4.6.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

##### 4.6.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ARFMATRIX'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Database for hxdarfgen. AEFs for incident angles.'	'Description
<b>Arf Files Keywords</b>		
EXTNAME	'ARFMATRIX'	'Name of the binary table extension
DETNAM	<detname>	'Detector name

Table 4.14 – Arf library Calibration Files Extension 1 Keywords

where <detname> is set to 'WELL\_GSO' and 'WELL\_PIN' for the files that reference to the GSO and PIN detectors respectively.

##### 4.6.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ART_ENERGIES'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Definition of the ARF table of the ... Channel'	'Description

	energy Channel'	
<b>Arf Files Keywords</b>		
EXTNAME	'ART_ENERGIES'	Name of the binary table extension
DETNAM	<detname>	Detector name

Table 4.15 – Arf library Calibration Files Extension 2 Keywords

where <detname> is set to 'WELL\_GSO' and 'WELL\_PIN' for the files that reference to the GSO and PIN detectors respectively.

#### 4.7 Threshold PIN Calibration File

##### 4.7.1 File Name

ae\_hxd\_pinthr\_YYYYMMDD.fits

##### 4.7.2 Description

This file contains information the PI threshold for the WELL\_PIN detector on the HXD which are used when “grading “ the data. The file format consists of an empty primary header with one binary table extensions.

##### 4.7.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	PINTHRES	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	UNIT_ID	B	-
	THRES_PIN0	D	chan
	THRES_PIN1	D	chan
	THRES_PIN2	D	chan
	THRES_PIN3	D	chan

Table 4.16 – Threshold Calibration Files Format

##### 4.7.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

##### 4.7.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'PINTHRES'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'PIN PI threshold in hxdgrade'	Description
<b>Threshold Files Keywords</b>		
EXTNAME	'PINTHRES'	Name of the binary table extension
DETNAM	'WELL_PIN'	Detector name

Table 4.17 – Threshold Calibration Files Extension 1 Keyword

#### 4.8 GSO gain history Calibration File

##### 4.8.1 File Name

ae\_hxd\_gsoghf\_YYYYMMDD.fits

##### 4.8.2 Description

This file contains the gain history for the GSO detector on the HXD instrument. This file is derived after fitting spectral lines from several data sets and it is used in the software to correct for the gain. The file format consists in a empty primary header and three binary extensions. The three extensions include the fitting results of the intrinsic Gd line at 348 keV, the annihilation line at 511 keV and the 153Gd line at 152 keV respectively.

##### 4.8.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	GSO_152GD_350KEV	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	

Extension N.	Type	Ext. Name	
	END_TIME	D	s
	EXPOSURE	D	s
	FIT_MODEL_ID	I	
	W<ij>_SLOW	15D	
	W<ij>_FAST	15D	
2	BINTABLE	GSO_ANNIHILATION_511KEV	
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	EXPOSURE	D	s
	FIT_MODEL_ID	I	
	W<ij>_SLOW	15D	
	W<ij>_FAST	15D	
3	BINTABLE	GSO_153GD_150KEV	
	BINTABLE	GSO_ANNIHILAT	
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	EXPOSURE	D	s
	FIT_MODEL_ID	I	
	W<ij>_SLOW	15D	
	W<ij>_FAST	15D	

Table 4.18 – GSO Gain History Files Format

where <ij> has 'i' ranges from 0-3 and 'j' ranges from 0-3 .

**4.8.4 Primary Header Keywords**

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

**4.8.5 Extension 1 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GAIN_HISTORY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Fit Results of the intrinsic Gd line on 348 keV.'	Description
CDB0001	'ENERG(348,348)'	Parameter boundaries
<b>Gain Files Keywords</b>		
EXTNAME	'GSO_152GD_350KEV'	Name of the binary table extension
DETNAME	'WELL_GSO'	Detector name

Table 4.19 – Gain GSO Calibration Files Extension 1 Keywords

**4.8.6 Extension 2 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GAIN_HISTORY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used

CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Fit Results of the Annihilation line on 511 keV.'	Description
CDB0001	'ENERG(511,511)'	Parameter boundaries
<b>Gain Files Keywords</b>		
EXTNAME	'GSO_ANNIHILATION_511KEV'	Name of the binary table extension
DETNAM	WELL_GSO	Detector name

Table 4.20 – Gain GSO Calibration Files Extension 1 Keywords

4.8.7 Extension 3 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GAIN_HISTORY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Fit Results of the line from 153Gd line on 152 keV.'	Description
CDB0001	'ENERG(148,148)'	Parameter boundaries
<b>Gain Files Keywords</b>		
EXTNAME	'GSO_153GD_150KEV'	Name of the binary table extension
DETNAM	WELL_GSO	Detector name

Table 4.21 – Gain GSO Calibration Files Extension 1 Keywords

4.9 PIN Gain History Calibration File

4.9.1 File Name

ae\_hxd\_pinghf\_YYYYMMDD.fits

4.9.2 Description

This file contains information the gain history for the WELL\_PIN detector on the HXD. The file format consists of an empty primary header with one binary table extensions.

4.9.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	PINTHRES	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	EXPOSURE	D	s
	PIN_ID	B	
	PIN_GAIN	D	
	PIN_GAIN_ERROR	D	
	PIN_OFFSET	D	
	PIN_OFFSET_ERROR	D	

Table 4.22 – PIN gain history Calibration Files Format

4.9.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

4.9.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment



CALDB Keywords		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'GAIN_HISTORY'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'PIN gain history table'	'Description
Threshold Files Keywords		
EXTNAME	'PIN_GHP'	'Name of the binary table extension
DETNAM	'WELL_PIN'	'Detector name

Table 4.23 – PIN Gain Calibration Files Extension 1 Keyword

## 4.10 Response Matrices

### 4.10.1 File Name

The name of the Response Matrix files depends on the nominal pointing position. The files are named following the convention:

ae\_hxd\_gso<xxxx>\_YYYYMMDD.rsp ae\_hxd\_pin<xxxx>\_YYYYMMDD.rsp

where <xxxx> is either 'xinom' or 'hxnom' depending if the pointing position was for the XIS or HXD nominal respectively.

### 4.10.2 Description

The response matrices are generated for individual detector of the HXD and they are applicable for spectra extracted in PI channel type. All available response matrices are included in CALDB and they can be added using software that operates on response matrices. The effective area is already included. The file format consists of an empty primary table and two binary table extensions named 'MATRIX' and 'EBOUNDS'. The 'MATRIX' includes the following columns:

- ENERG\_LO: lower energy bound of the energy bin;
- ENERG\_HI: upper energy bound of the energy bin;
- N\_GRP: number of channel subset for the energy bin;
- F\_CHAN: channel number of the of the start of each 'channel subset' for the energy bin;
- N\_CHAN: number of channels within each 'channel subset' for the energy bin;
- MATRIX: response values for each 'channel subset' for the energy bin.

The EBOUNDS extension contains:

CHANNEL is the channel number.

E\_MIN is the energy in keV corresponding to the start of the channel.

E\_MAX is the energy in keV corresponding to the stop of the channel.

### 4.10.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
1	BINTABLE	MATRIX	
	ENERG_LO	E	keV
	ENERG_HI	E	keV
	N_GRP	I	-
	F_CHAN	J	-
	N_CHAN	J	-
	MATRIX	<i>E	-
2	BINTABLE	EBOUNDS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	CHANNEL	I	chan
	E_MIN	E	keV
	E_MAX	E	keV

Table 4.24 - Response Matrix Calibration File Format

where <i> is the max number of elements in the array either 256 or 512 for PIN and GSO respectively.

### 4.10.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

### 4.10.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
CALDB Keywords		
CCLS0001	'CPF'	'Dataset is a Calibration product File

CCNM0001	'SPECRESP MATRIX'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Response Matrix'	Description
EXTNAME	'MATRIX'	Extension name
HUCLASS	'OGIP'	Format conforms to OGIP standards
HUCLAS1	'RESPONSE'	Extension contains response data
HUCLAS2	'RSP_MATRIX'	Extension contains RMF
HUCLAS3	'FULL'	Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
<b>Response Matrix PIN File Keywords</b>		
CBD10001	'POINTING(iiii)'	Parameter boundary
CHANTYPE	'PI_PIN'	Channel type
DETHANS	256	Total number of detector channels
DETNAM	'WELL_PIN'	Detector name
<b>Response Matrix GSO File Keywords</b>		
CBD10001	'POINTING(iiii)'	Parameter boundary
CHANTYPE	'PI_SLOW'	Channel type
DETHANS	512	Total number of detector channels
DETNAM	'WELL_GSO'	Detector name

Table 4.25 - Response Matrix Calibration File Extension 1 Keywords

where <iiii> is either HXD NOM or ONAXIS to indicate if the nominal pointing is for the HXD or XIS.

#### 4.10.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'CPF'	Dataset is a Calibration product File

CCNM0001	'EBOUNDS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'EBOUNDS'	Description
EXTNAME	'EBOUNDS'	Extension name
HUCLASS	'OGIP'	Format conforms to OGIP standards
HUCLAS1	'RESPONSE'	Extension contains response data
HUCLAS2	'EBOUNDS'	Extension contains RMF
HUCLAS3	'FULL'	Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
<b>Ebounds PIN File Keywords</b>		
CBD20001	'POINTING(iiii)'	Parameter boundary
CHANTYPE	'PI_PIN'	Channel type
DETHANS	256	Total number of detector channels
DETNAM	'WELL_PIN'	Detector name
<b>Ebounds GSO File Keywords</b>		
CBD10001	'POINTING(iiii)'	Parameter boundary
CHANTYPE	'PI_SLOW'	Channel type
DETHANS	512	Total number of detector channels
DETNAM	'WELL_GSO'	Detector name

Table 4.26 - Response Matrix Calibration File Extension 2 Keyword

where <iiii> is either HXNOM or ONAXIS to indicate if the nominal pointing is for the HXD or XIS.

## 5 XIS files format

### 5.1 Telescope Definition File

#### 5.1.1 File Name

The Telescope Definition Calibration file is also known as teldef. There is one teldef file for each of the unit on board Suzaku using the following naming convention :

ae\_xil\_teldef\_YYYYMMDD.fits where I=0,3 to identify the 4 XIS units

**5.1.2 Description**

The XIS data reduction software requires as input the Telescope Definition file (teldef). This is a FITS file containing in the primary HDU a set of keywords describing the telescope and instrument characteristics, the coordinate systems definition and the transformations between them. There are 5 sets of coordinates defined for the Suzaku XIS: raw (RAW), actual (ACT), detector (DET), focal (FOC), and sky (SKY).

The RAW coordinates come from the telemetry and numbered accordingly with the segment on the CCD. The ACT coordinates number pixel spanning the entire CCD and are looking down. The DET coordinates are the look-up system. The FOC coordinates are the focal plane coordinates where the XRS and XIS are aligned and the finally the SKY are mapped into the sky and provide the RA and Dec for each pixel.

The keyword NCOORDS set to 5 gives the total coordinate systems in use and the different coordinate systems are specified in the keywords COORDn (n=0,4). For each set of coordinates there are several keywords describing how the pixel are numbered as well as the values for the coefficient that are used in the transformation from the one system to another.

**5.1.3 File Format**

Extension N.	Type	Ext. Name
0	PRIMARY	

Table 5.1 - Telescope Description Calibration File Format

**5.1.4 Primary Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'TELDEF'	/Type of calibration data
CDTP0001	'DATA'	/Calibration file contains data
CVSD0001	'YYYY-MM-DD'	/UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	/UTC time when calibration should first be used
CBD10001	'FORMAT_VERSION(2)'	/Format version of the Suzaku teldef file
CDES0001	'TELESCOPE DEFINITION FILE'	/Description
<b>Instrument keyword</b>		
INSTRUME	'XIS<i>'	/Instrument name

Table 5.2 - Telescope Description File Primary Header Keywords

where <i> is a number ranging from 0 to 3 to identify the XIS units.

**5.2 XIS Bad columns Calibration File**

**5.2.1 File Name**

ae\_xil\_badcolumn\_YYYYMMDD.fits where I=0,3 to identify the 4 XIS units

**5.2.2 Description**

This file contains the coordinates of the XIS bad columns and reason why they are flagged bad. The file format consists of an empty primary header with one binary table extensions.

**5.2.3 File Format**

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	BADCOLUMNS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	START	D	s
	STOP	D	s
	SEGMENT	I	
	RAWX	I	pixel
	RAWY1	I	pixel
	RAWY2	I	pixel
	ACTX	I	pixel
	ACTY1	I	pixel
ACTY2	I	pixel	
BCCODE	32X		

Table 5.3 - Bad columns Calibration Files Format

**5.2.4 Primary Header Keywords**

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

**5.2.5 Extension 1 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
--------------	---------------	---------

Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
CALDB Keywords		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'BADPIX'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'BAD column file'	'Description
Other File Keywords		
EXTNAME	'BADCOLUMNS'	'Name of the binary table extension
INSTRUME	'XIS<i>'	'Instrument name

Table 5.4 – Bad columns Calibration Files Extension 1 Keyword

where <i> is a number ranging from 0 to 3 to identify the XIS units.

### 5.3 XIS Calibration sources Mask File

#### 5.3.1 File Name

ae\_xil\_calmask\_YYYYMMDD.fits where I=0,3 to identify the 4 XIS units

#### 5.3.2 Description

This file contains an image with the location of the XIS calibration sources. The location of the calibration sources is marked with pixel values set to 0 all other pixels are set to 1. These images are made for the ACT coordinates system.

#### 5.3.3 File Format

Extension N.	Type	Ext. Name
0	PRIMARY	

Table 5.5 – Mask Calibration File Format

#### 5.3.4 Primary Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
--------------	---------------	---------

Table 3.1 & 3.2 - Mandatory header keywords		
CALDB Keywords		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'CALMASK'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Calibration source mask file'	'Description
Instrument keyword		
INSTRUME	'XIS<i>'	'Instrument name

Table 5.6 – Mask Calibration File Primary Header Keywords

where <i> is a number ranging from 0 to 3 to identify the XIS units.

### 5.4 XIS CTI Calibration File

#### 5.4.1 File Name

ae\_xil\_makepi\_YYYYMMDD.fits where I=0,3 to identify the 4 XIS units

#### 5.4.2 Description

This file contains the information related to the change transfer inefficiency (CTI) that is used in the calculation of the PI values. The file format consists of an empty primary header with seven binary table extensions.

#### 5.4.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	CHARGETRAIL	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(1024)	
	RAWX	PI(1024)	
	TrailH	PI(1024)	
	TrailV	PI(1024)	

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
	AlphaH	PI(1024)	
	AlphaV	PI(1024)	
	OffsetRAWX	PI(1024)	
	OffsetACTY	PI(1024)	
2	BINTABLE	PARALLEL_CTI	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(1024)	
	RAWX	PI(1024)	
	CTL_CONST	PE(1024)	l/chan
	CTL_NORM	PE(1024)	l/chan
	CTL_POW	PE(1024)	
3	BINTABLE	SERIAL_CTI	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(4)	
	CTL_CONST	PE(4)	l/chan
	CTL_NORM	PE(4)	l/chan
4	BINTABLE	SPTH_PARAM	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(4)	
	OFFSET	PE(4)	chan
	SLOPE	PE(4)	
	MINIMUM	PE(4)	chan
5	BINTABLE	GAIN-AETEMP	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
	Segment	PI(4)	
	NORM	PE(4)	
	OFFSET	PE(4)	
	POW	PE(4)	
6	BINTABLE	GAIN_NORMAL	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(4)	
	QUAD_LOW	PI(4)	eV/chan**2
	LINR_LOW	PI(4)	eV/chan
	OFFSET_LOW	PI(4)	eV
	QUAD_HIGH	PI(4)	eV/chan**2
	LINR_HIGH	PI(4)	eV/chan
	OFFSET_HIGH	PI(4)	eV
	AETemp	PI(4)	
7	BINTABLE	GAIN_PSUM	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Segment	PI(4)	
	QUAD_LOW	PI(4)	eV/chan**2
	LINR_LOW	PI(4)	eV/chan
	OFFSET_LOW	PI(4)	eV
	QUAD_HIGH	PI(4)	eV/chan**2
	LINR_HIGH	PI(4)	eV/chan
	OFFSET_HIGH	PI(4)	eV
	AETemp	PI(4)	

Table 5.7 – Charge transfer Calibration Files Format

#### 5.4.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

#### 5.4.5 Extension 1 to 7 - Header Keywords

All keywords listed in Table 3.1, 3.2 and 3.4 should be included in the header for all seven HDUs. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords all HDU		
<b>CALDB and Instrument keywords all extensions</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Parameters to calculate the PI'	Description
INSTRUME	'XIS<i>'	Instrument name
<b>Extension 1 CALDB keyword setting</b>		
EXTNAME	'CHARGETRAIL'	Name of the binary table extension
CCNM0001	'CHARGETRAIL'	Type of calibration data
<b>Extension 2 CALDB keyword setting</b>		
EXTNAME	'PARALLEL_CTI'	Name of the binary table extension
CCNM0001	'PARELLEL_CTI'	Type of calibration data
<b>Extension 3 CALDB keyword setting</b>		
EXTNAME	'SERIAL_CTI'	Name of the binary table extension
CCNM0001	'SERIAL_CTI'	Type of calibration data
<b>Extension 4 CALDB keyword setting</b>		
EXTNAME	'SPTH_PARAM'	Name of the binary table extension
CCNM0001	'SPTH_PARAM'	Type of calibration data
<b>Extension 5 CALDB keyword setting</b>		
EXTNAME	'GAIN-AETEMP'	Name of the binary table extension
CCNM0001	'GAIN-AETEMP'	Type of calibration data

<b>Extension 6 CALDB keyword setting</b>		
EXTNAME	'GAIN_NORMAL'	Name of the binary table extension
CCNM0001	'GAIN_NORMAL'	Type of calibration data
<b>Extension 7 CALDB keyword setting</b>		
EXTNAME	'GAIN_PSUM'	Name of the binary table extension
CCNM0001	'GAIN_PSUM'	Type of calibration data

*Table 5.8 – Charge transfer Calibration Files Extension 1-7 Keyword*

where <i> is a number ranging from 0 to 3 to identify the XIS units.

#### 5.5 XIS quantum efficiency Calibration File

##### 5.5.1 File Name

ae\_xil\_quanteff\_YYYYMMDD.fits where l=0,3 to identify the 4 XIS units

##### 5.5.2 Description

This file contains the information related to the quantum efficiency. The file format consists of an empty primary header with four binary table extensions.

##### 5.5.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	EFFICIENCY_CC	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Energy	PE(4623)	
	QE_s0_p0	PE(4623)	
	QE_s0_p1	PE(4623)	
	QE_s0_p2	PE(4623)	
	QE_s0_p3	PE(4623)	
	QE_s1_p0	PE(4623)	
	QE_s1_p1	PE(4623)	
	QE_s1_p2	PE(4623)	
	QE_s1_p3	PE(4623)	

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
	QE_s2_p0	PE(4623)	
	QE_s2_p1	PE(4623)	
	QE_s2_p2	PE(4623)	
	QE_s2_p3	PE(4623)	
	QE_s3_p0	PE(4623)	
	QE_s3_p1	PE(4623)	
	QE_s3_p2	PE(4623)	
	QE_s3_p3	PE(4623)	
2	BINTABLE	EFFICIENCY_OB	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Energy	PI(1850)	
	QE_s0_p0	PE(1850)	
	QE_s0_p1	PE(1850)	
	QE_s0_p2	PE(1850)	
	QE_s0_p3	PE(1850)	
	QE_s1_p0	PE(1850)	
	QE_s1_p1	PE(1850)	
	QE_s1_p2	PE(1850)	
	QE_s1_p3	PE(1850)	
	QE_s2_p0	PE(1850)	
	QE_s2_p1	PE(1850)	
	QE_s2_p2	PE(1850)	
	QE_s2_p3	PE(1850)	
	QE_s3_p0	PE(1850)	
	QE_s3_p1	PE(1850)	
	QE_s3_p2	PE(1850)	
	QE_s3_p3	PE(1850)	
3	BINTABLE	EDGE_CCD	

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
4	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Energy	PE(2)	keV
	BINTABLE	EDGE_OBF	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Energy	PE(4)	keV

Table 5.9 – Quantum Efficiency Calibration Files Format

#### 5.5.4 Primary Header Keywords

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

#### 5.5.5 Extension 1 to 4 - Header Keywords

All keywords listed in Table 3.1, 3.2 and 3.4 should be included in the header of the four HDUs. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords all HDU		
<b>CALDB and Instrument keywords all extensions</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
INSTRUME	'XIS<i>	Detector name
<b>Extension 1 CALDB keyword setting</b>		
EXTNAME	'EFFICIENCY_CCD'	Name of the binary table extension
CCNM0001	'EFFICIENCY_CCD'	Type of calibration data
CDES0001	'Quantum efficiency of CCD '	Description
<b>Extension 2 CALDB keyword setting</b>		
EXTNAME	'EFFICIENCY_OBF'	Name of the binary table extension

CCNM0001	'EFFICENCY_OBF'	Type of calibration data
CDES0001	'Transmission of OBF '	Description
<b>Extension 3 CALDB keyword setting</b>		
EXTNAME	'EDGE_CCD'	Name of the binary table extension
CCNM0001	'EDGE_CCD'	Type of calibration data
CDES0001	'Atomic edge of CCD '	Description
<b>Extension 4 CALDB keyword setting</b>		
EXTNAME	'EDGE_OBF'	Name of the binary table extension
CCNM0001	'EDGE_OBF'	Type of calibration data
CDES0001	'Atomic edge of OBF'	Description

Table 5.10 – Charge transfer Calibration Files Extension 1-7 Keyword

where <i> i </i> is a number ranging from 0 to 3 to identify the XIS units.

**5.6 XIS parameters to build the RMF Calibration File**

**5.6.1 File Name**

ae\_xi\_rmtparam\_YYYYMMDD.fits where I=0,3 to identify the 4 XIS units

**5.6.2 Description**

This file contains the instrumental parameters that are used in the XIS response builder software. The file format consists of an empty primary header with one binary table extension.

**5.6.3 File Format**

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	BADCOLUMNS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Time	E	s
	Param_s0_p0	PE(32)	
	Param_s0_p1	PE(32)	
	Param_s0_p2	PE(32)	
	Param_s0_p3	PE(32)	
	Param_s1_p0	PE(32)	

Extension N.	Type	Ext. Name	
	Param_s1_p1	PE(32)	
	Param_s1_p2	PE(32)	
	Param_s1_p3	PE(32)	
	Param_s2_p0	PE(32)	
	Param_s2_p1	PE(32)	
	Param_s2_p2	PE(32)	
	Param_s2_p3	PE(32)	
	Param_s3_p0	PE(32)	
	Param_s3_p1	PE(32)	
	Param_s3_p2	PE(32)	
	Param_s3_p3	PE(32)	

Table 5.11– RMF parameter building Calibration Files Format

**5.6.4 Primary Header Keywords**

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

**5.6.5 Extension 1 - Header Keywords**

All keywords listed in Table 3.1, 3.2 and 3.4 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'RMF_PARAMETERS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Parameters to calculate RMF'	Description
<b>Other File Keywords</b>		



EXTNAME	'RMF_PARAMETERS'	Name of the binary table extension
INSTRUME	'XIS<i>'	Instrument name

Table 5.12 – RMF parameter Calibration Files Extension 1 Keyword

where <i> is a number ranging from 0 to 3 to identify the XIS units.

**5.7 XIS Micro code id Calibration File**

**5.7.1 File Name**

ae\_xis\_ucodelst\_YYYYMMDD.fits

**5.7.2 Description**

This file contains the identification of the micro code assigned for each of mode running for the XIS. The code is identical for the four units on board SUZAKU. The file format consists of an empty primary header with one binary table extension.

**5.7.3 File Format**

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	UCODE_LIST	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	CODE_ID	I	
	TGT_SENSOR	I	
	CLKMOD	I	
	WINOPT	I	
	WIN_ST	I	
	WIN_SIZ	I	
	PSUM_L	I	
	CI	I	
	BINNING	I	
	SRAM_VER	I6A	
	SNAPTIME	I6D	s

Extension N.	Type	Ext. Name	
	DELAY	I6D	s
	COMMENT	I64A	

Table 5.13 – Ucode1st Calibration Files Format

**5.7.4 Primary Header Keywords**

All header keywords of Table 3.1 and applicable to this instrument are mandatory.

**5.7.5 Extension 1 - Header Keywords**

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'u-code List'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XIS u-code list'	'Description
<b>Other File Keywords</b>		
EXTNAME	'UCODE_LIST'	'Name of the binary table extension
INSTRUME	'XIS'	'Instrument name

Table 5.14 – Ucode1st Calibration Files Extension 1 Keyword

where <i> is a number ranging from 0 to 3 to identify the XIS units.

**5.8 XIS Response Matrices**

**5.8.1 File Name**

ae\_xil\_YYYYMMDD.rmF where I=0,3 to identify the 4 XIS units

### 5.8.2 Description

The response matrices are generated for individual detector of the XIS and they are applicable for spectra extracted in PI channel type. All available response matrices are included in CALDB and they can be added using software that operates on response matrices. The files should be used in conjunction with arfs. The file format consists of an empty primary table and two binary table extensions named 'MATRIX' and 'EBOUNDS'. The 'MATRIX' includes the following columns:

- ENERG\_LO: lower energy bound of the energy bin;
- ENERG\_HI: upper energy bound of the energy bin;
- N\_GRP: number of channel subset for the energy bin;
- F\_CHAN: channel number of the of the start of each 'channel subset' for the energy bin;
- N\_CHAN: number of channels within each 'channel subset' for the energy bin;
- MATRIX: response values for each 'channel subset' for the energy bin.

The EBOUNDS extension contains:

- CHANNEL is the channel number.
- E\_MIN is the energy in keV corresponding to the start of the channel.
- E\_MAX is the energy in keV corresponding to the stop of the channel.

### 5.8.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
1	BINTABLE	MATRIX	
	ENERG_LO	E	keV
	ENERG_HI	E	keV
	N_GRP	I	-
	F_CHAN	I	-
	N_CHAN	I	-
	MATRIX	PE(x)	-
2	BINTABLE	EBOUNDS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	CHANNEL	J	-
	E_MIN	E	keV
	E_MAX	E	keV

Table 5.15 - Response Matrix Calibration File Format

where 'x' is the size of the MATRIX array that varies in each XIS unit.

### 5.8.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

### 5.8.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'CPF'	'Dataset is a Calibration product File
CCNM0001	'SPECRESP MATRIX'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XIS Segment C RMF based on ground and in-orbit calibration'	'Description
CBD10001	'DETCANS(4096)'	'Parameter boundary
CBD20001	'CHAN(0-4095)'	'Parameter boundary
CBD30001	'CHANTYPE("PI")'	'Parameter boundary
<b>Response Matrix File Keywords</b>		
EXTNAME	'MATRIX'	'Extension name
HUCLASS	'OGIP'	'Format conforms to OGIP standards
HUCLAS1	RESPONSE	'Extension contains response data
HUCLAS2	RSP_MATRIX	'Extension contains RMF
HUCLAS3	DETECTOR	'convolved w/ detector effects (only)
CHANTYPE	PI	'Channel type
DETCANS	4096	'Total number of detector channels
INSTRUME	'XIS<i>'</i>'	'Instrument name

Table 5.16 - Response Matrix Calibration File Extension 1 Keywords

where <i> ranges from 0 to 3.

### 5.8.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'CPF'	'Dataset is a Calibration product File
CCNM0001	'EBOUNDS'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Energies boundaries of spectral bins'	'Description
CBD10001	'DETHANS(4096)'	'Parameter boundary
CBD20001	'CHAN(0-4095)'	'Parameter boundary
CBD30001	'CHANTYPE("PI")'	'Parameter boundary
<b>Response Matrix File Keywords</b>		
EXTNAME	'EBOUNDS'	'Extension name
HUCLASS	'OGIP'	'Format conforms to OGIP standards
HUCLAS1	'RESPONSE'	'Extension contains response data
HUCLAS2	'EBOUNDS'	'Extension contains RMF
CHANTYPE	'PI'	'Channel type
DETHANS	'4096'	'Total number of detector channels
INSTRUME	'XIS<i>'	'Instrument name

Table 5.17 - Response Matrix Calibration File Extension 2 Keyword

where <i> ranges from 0 to 3.

## 5.9 Ancillary Response File

### 5.9.1 File name

There two sets of arf file for each of the XIS detector unit, one when the nominal pointing position is on the XIS (onaxis) and the other is when the nominal pointing position is on the HXD (hxdnom). The files for the two sets of arfs are named following the convention:

ae\_xiI\_onaxis\_YYYYMMDD.arf & ae\_xiI\_hxdnom\_YYYYMMDD.arf

where I=0,3 to identify the 4 XIS units.

### 5.9.2 Description

The ARF stored in the CALDB are standard ARFs for a typical extraction radius optimized on the two possible nominal positions driven by the XIS or by the HXD. For each nominal position there one ARF for each of the XIS detector units. The file format consists in an empty primary table and a binary table extension.

### 5.9.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	SPECRESP	
	Column Names	Format	Units
	ENERG_LO	E	keV
	ENERG_HI	E	keV
	SPECRESP	E	cm**2
	EFFAREA	E	cm**2
EXPOSURE	E	-	

Table 5.18 - Ancillary Response Calibration File Format

### 5.9.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

### 5.9.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and Others Keywords</b>		
CCLS0001	'CPF'	'Dataset is a Calibration Product File

CCNM0001	'SPECRESP'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CBD10001	'ENERG(0.2-12.0)keV'	Parameter boundary
EXTNAME	'SPECRESP '	Extension name
INSTRUME	'XIS<i>'	Instrument name
HDUCLASS	'OGIP'	Format conforms to OGIP/GSFC conventions
HDUCLAS1	'RESPONSE'	Extension contains response data
HDUCLAS2	'SPECRESP'	Extension contains response data
<b>Boundary Keywords for XIS NOMINAL</b>		
CBD20001	'POINTING(ONAXIS)'	Parameter boundary
CDES0001	'XIS<i> ARF for onaxis position'	Description
<b>Boundary Keywords for HXD NOMINAL</b>		
CBD20001	'POINTING(HXDNOM)'	Parameter boundary
CDES0001	'XIS<i> ARF for hxdnom position'	Description

Table 5.19 - Ancillary Response Calibration File Extension 1 Keywords

where <i> ranges from 0 to 3.

## 5.10 XIS contamination file

### 5.10.1 File Name

ae\_xi\_contami\_YYYYMMDD.rmf where I=0,3 to identify the 4 XIS units

### 5.10.2 Description

This file contains the growth curve of the XIS Optical Blocking Filter (OBF) contamination. The contamination depends on both time and detected position. There is one file for each of the detectors. The file format consist of an empty primary table and two binary table extensions named 'CONTAMI\_GROWTH' and 'CONTAMI\_TRANS'. The columns in the first extension are :

- TIME: Time is seconds since the zero time of the mission
- DATE: Time given as an ISO format
- A, B, C : are the coefficients in the formula that describes the contamination

The columns in the second extension are:

- ENERGY: energy in keV at which the transmission is given.

- TRANSMIS: transmission.

### 5.10.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
1	BINTABLE	CONTAMI_GROWTH	
	TIME	D	s
	DATE	I6A	
	A	E	arcmin
	B	E	-
	C	E	10**18 cm**(-2)
2	BINTABLE	EBOUNDS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	E	keV
	TRANSMISS	E	-

Table 5.20 - Response Matrix Calibration File Format

### 5.10.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

### 5.10.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1, 3.2 and 3.4 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 & 3.4 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is a Calibration product File
CCNM0001	'CONTAMI_GROWTH'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'Contamination Growth curve	'Description

	growth'	
CBD10001	'FORMAT_VERSION(1)'	Parameter boundary
<b>Contamination 1<sup>st</sup> File Keywords</b>		
EXTNAME	'CONTAMI_GROWTH'	Extension name

Table 5.21 - Contamination Calibration File Extension 1 Keywords

where <i> ranges from 0 to 3.

### 5.10.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is a Calibration product File
CCNM0001	'CONTAMI_TRANS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'Contamination Transmission'	Description
CBD10001	'FORMAT_VERSION(1)'	Parameter boundary
<b>Response Matrix File Keywords</b>		
EXTNAME	'CONTAMI_TRANS'	Extension name

Table 5.22 - Contamination Calibration File Extension 2 Keyword

## 6 XRS files format

### 6.1 Telescope Definition File

#### 6.1.1 File Name

ae\_xrs\_teldef\_YYYYMMDD.fits

#### 6.1.2 Description

The XRS data reduction software requires the Telescope Definition file (teldef) as input. This is a FITS file containing in the primary HDU a set of keywords describing the telescope and instrument characteristics, the coordinate systems definition and the transformations between them. There are 4 sets of coordinates defined for the Suzaku XRS: raw (RAW), detector (DET), focal (FOC), and sky (SKY). In addition for the XRS there is one binary extension that defined the positions of the four corners of each pixel.

The RAW coordinates numbers the 32 distinct pixels and they are defined using the corners of the pixel reported in the second extension of the file. The DET coordinates are the look-up system. The FOC coordinates are the focal plane coordinates where the XRS and XIS are aligned and finally the SKY are mapped into the sky and provide the RA and Dec for each pixel.

The keyword NCOORDS set to 4 gives the total coordinate systems in use and the different coordinate systems are specified in the keywords COORDn (n=0,3). For each set of coordinates there are several keywords describing how the pixel are numbered as well as the values for the coefficient that are used in the transformation from the one system to another.

#### 6.1.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	PIXEL_MAP	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	PIXEL	I	-
	PIXELX	4E	mm
	PIXELY	4E	mm

Table 6.1 - Telescope Description Calibration File Format

#### 6.1.4 Primary Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'TELDEF'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used

CDES0001	TELESCOPE DEFINITION FILE'	Description
----------	----------------------------	-------------

Table 6.2 - Telescope Description File Primary Header Keywords

### 6.1.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 – Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is a Basic Calibration File
CCNM0001	'PIXEL_MAP'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XRS Pixel configuration map'	'Description (see separate table)
<b>Teldef File Keywords</b>		
EXTNAME	'PIXEL_MAP'	Name of the binary table extension

Table 6.3 – XRS Teldef First extension Keywords

## 6.2 Bad Pixel Table File

### 6.2.1 File Name

ae\_xrs\_badpix\_YYYYMMDD.fits

### 6.2.2 Description

The file contains the list of bad pixel in the XRS detector. The file format consists in an empty primary header and one binary extension with the following columns:

- PIXEL: contains the bad pixel. This is ID with a value ranging between 0-31.
- TIME: is the time after which the pixel is known to be bad. The time is written as mission elapsed time in seconds.
- TIME\_END: is the time when the pixel is no longer considered bad. The time is written as mission elapsed time in seconds.
- DATE: contains the same information that is TIME but reports the time as an UTC values in ISO format.

- DATE\_END: contains the same information that is TIME\_END but reports the time as an UTC values in ISO format. A new row is added to this file when new pixel locations are found to be bad.

### 6.2.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	BADPIX	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	PIXEL	B	-
	TIME	D	s
	TIME_END	D	s
	DATE	19A	-
	DATE_END	19A	-

Table 6.4 – XRS Bad Pixel Calibration File Format

### 6.2.4 Primary Header Keywords

All keywords of Table 3.1 and applicable to this instrument are mandatory.

### 6.2.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1, 3.2 and 3.4 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is a Basic Calibration File
CCNM0001	'BADPIX'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XRS BAD PIXEL LIST'	'Description (see separate table)

Badpix File Keywords		
EXTNAME	'BADPIX'	Name of the binary table extension

Table 6.5 - Bad Pixel Calibration File Extension 1 Keywords

### 6.3 Blocking Filter Calibration File

#### 6.3.1 File Name

ae\_xrs\_bkcfilt\_YYYYMMDD.fits

#### 6.3.2 Description

This file contains the measurements of the transmission for the optical blocking filter. The file format consists of an empty primary header with a binary extension containing the following columns:

- ENERGY contains the energy values used to determinate the transmission.
- TRANSMIS contains the corresponding transmission values. Note that these values are result of a calculation in the first release and from measurements in later releases.

#### 6.3.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	BLCKFILT	
	Column Names	Format	Units
	ENERGY	D	keV
	TRANSMIS	D	-

Table 6.6 – Blocking Filter Calibration File Format

#### 6.3.4 Primary Header Keywords

All keywords of Table 3.1 relevant to this instrument are mandatory.

#### 6.3.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'FTRANS'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XRS BLOCKING FILTER TRANSMISSION FILE'	'Description
<b>Optical Blocking Filter File Keywords</b>		
EXTNAME	'BLCKFILT'	'Name of the binary table extension
FILTER	'BLCKFILT'	'Filter keyword

Table 6.7 – Blocking Filter Calibration File Extension 1 Keywords

### 6.4 Filter Transmission Calibration Files

#### 6.4.1 File Name

ae\_xrs\_fw3bn\_YYYYMMDD.fits & ae\_xrs\_fw4bc\_YYYYMMDD.fits

ae\_xrs\_fw5nn\_YYYYMMDD.fits & ae\_xrs\_fw6nc\_YYYYMMDD.fits

#### 6.4.2 Description

These files contain the measurements of the transmission for the filter on the filter wheel that are located in front of the XRS. There are 6 different positions on the filter wheel and they corresponds to the following filters: open (position 1), open with calibration source (position 2), beryllium (position 3), beryllium with calibration source (position 4), neutral (position 5), neutral with calibration source (position 6). The calibration files in CALDB are for the beryllium and neutral filters. The file format consists of an empty primary header with a binary extension containing the following columns:

- ENERGY contains the energy values used to determinate the transmission.
- TRANSMIS contains the corresponding transmission values. The values are based on calibration measurements done at ISAS and are valid for the 0.01-20 keV energy range.

#### 6.4.3 File Format

Extension N.	Type	Ext. Name
0	PRIMARY	
1	BINTABLE	FTRANS

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	E	keV
	TRANSMIS	E	-

Table 6.8 – Filter transmission Calibration File Format

#### 6.4.4 Primary Header Keywords

All keywords of Table 3.1 relevant to this instrument are mandatory.

#### 6.4.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'FTRANS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CBD10001	'ENERG(0.01-20.0)'	Parameter boundaries
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRS Filter Wheel position <type> filter transmission'	Description
<b>Filter Transmission File Keywords</b>		
EXTNAME	'FTRANS'	Name of the binary table extension
FILTER	<string>	Filter keyword

Table 6.9 - Filter Transmission Calibration File Extension 1 Keywords

where <type> is set to 'Pos-3 Be 300um NoCAL' for the beryllium filter; to 'Pos-4 Be 300um CAL' for the beryllium filter with the calibration source, 'Pos-5 ND 10% No CAL' for the neutral density filter; to 'Pos-6 ND 10% CAL' for the neutral density filter with the calibration source. The string for the FILTER keyword is set to BE300, BE300\_CAL, ND10, and ND10\_CAL for the filter wheel position index set to 3, 4, 5 and 6 respectively.

## 6.5 Gate Valve Calibration File

### 6.5.1 File Name

ae\_xrs\_gatevalv\_YYYYMMDD.fits

### 6.5.2 Description

This file contains the measurements of the gate valve located in front of the detector. When in flight the gate valve will be open and will not be any longer in front detector. The file format consists of an empty primary header with a binary extension containing the following columns:

- ENERGY contains the energy values used to determinate the transmission.
- TRANSMIS contains the corresponding transmission values. The values are based on calibration measurements done at ISAS and are valid for the 0.01-20 keV energy range.

### 6.5.3 File Format

<i>Extension N.</i>	<i>Type</i>	<i>Ext. Name</i>	
0	PRIMARY		
1	BINTABLE	FTRANS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	E	keV
	TRANSMIS	E	-

Table 6.10 – Gate Valve Calibration File Format

### 6.5.4 Primary Header Keywords

All keywords of Table 3.1 relevant to this instrument are mandatory.

### 6.5.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'FTRANS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CBD10001	'ENERG(0.01-20.0)'	Parameter boundaries



CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRS Ne Dewar Gate Valve Be 10um filter transmission'	Description
<b>Gate valve Transmission File Keywords</b>		
EXTNAME	'FTRANS'	Name of the binary table extension
FILTER	'GATEVALV'	Filter keyword

Table 6.11 – Gate Valve Transmission Calibration File Extension 1 Keywords

## 6.6 Quantum Efficiency Calibration File

### 6.6.1 File Name

ae\_xrs\_qe\_YYYYMMDD.fits

### 6.6.2 Description

This file contains the Quantum Efficiency of the absorber and it is derived from calculation and from measurements. The file format consists in an empty primary table and a binary table extension with the following columns:

- ENERGY contains the energy values used to evaluate the quantum efficiency.
- QE contains the corresponding quantum efficiency.

### 6.6.3 File Format

The following tables list the structure for the quantum efficiency files for the 3 different modes.

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	QE	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	D	keV
	QE	D	-

Table 6.12 – Quantum Efficiency Calibration File Format

### 6.6.4 Primary Header Keywords

All keywords of Table 3.1 relevant to the instrument are mandatory.

### 6.6.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'QE'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRS Quantum Efficiency '	Description
<b>Quantum Efficiency File Keywords</b>		
EXTNAME	'QE'	Name of the binary table extension

Table 6.13 - Quantum Efficiency Calibration File Extension 1 Keywords

## 6.7 Gain Calibration File

### 6.7.1 File Name

ae\_xrs\_gain\_YYYYMMDD.fits

### 6.7.2 Description

This file contains the coefficients to calculate the gain for the XRS. This file will change with time, and new rows are added when new gain coefficient are recalculated. The file format consists in an empty primary table and a binary table extension with the following columns:

- START contains the mission elapsed time seconds corresponding to the start time when the coefficients are valid.
- STOP contains the mission elapsed time seconds corresponding to the stop time when the coefficients are valid.
- DATE\_START contains the ISO format of the time corresponding to the start time when the coefficients are valid.
- DATE\_STOP contains the ISO format of the UTC time corresponding to the stop time when the coefficients are valid.
- METHOD contains a flag that identifies the method used to calculate the coefficients.
- PIXEL contains the pixel number.
- NP contains number of coefficients used in the fit (it is n-1 since the constant of the polynomial is always set to zero and not stored in this file).
- P1, P2 and P3 are the columns containing the coefficients.

### 6.7.3 File Format

The following tables list the structure for the quantum efficiency files for the 3 different modes.

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	GAIN_PARAMETERS	
	Column Names	Format	Units
	START	D	s
	STOP	D	s
	DATE_START	I9A	-
	DATE_STOP	I9A	-
	METHOD	B	-
	PIXEL	B	-
	NP	B	-
	P1	D	-
	P2	D	-
	P3	D	-

Table 6.15 – Gain Calibration File Format

### 6.7.4 Primary Header Keywords

All keywords of Table 3.1 relevant to the instrument are mandatory.

### 6.7.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GAIN_PARAMETERS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data

CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRS GAIN PARAMETERS '	Description
<b>Gain File Keywords</b>		
EXTNAME	'GAIN_PARAMETERS'	Name of the binary table extension
PI_ESCAL	0.5	energy scale of PI [eV/chan]

Table 6.16 – Gain Calibration File Extension 1 Keywords

## 6.8 Response Matrices

### 6.8.1 File Name

The name of the Redistribution Matrix files depends on the pixel number as well as on the position filter. The files are named following the convention:

ae\_xrs\_pix<NN>\_YYYYMMDDvNNN.rmf

where <NN> gives the pixel number. NN is a two digits string ranging from 00 to 31 with 02 omitted.

### 6.8.2 Description

The response matrices are generated for different pixels. They are applicable for spectra extracted in PI channel type. All available response matrices are included in CALDB and they can be added using software that operates on response matrices. The file format consists of an empty primary table and two binary table extensions named 'MATRIX' and 'EBOUNDS'. The 'MATRIX' includes the following columns:

- ENERG\_LO: lower energy bound of the energy bin;
- ENERG\_HI: upper energy bound of the energy bin;
- N\_GRP: number of channel subset for the energy bin;
- F\_CHAN: channel number of the of the start of each 'channel subset' for the energy bin;
- N\_CHAN: number of channels within each 'channel subset' for the energy bin;
- MATRIX: response values for each 'channel subset' for the energy bin.

The 'EBOUNDS' extension includes the following columns :

- CHANNEL: contains the channel number
- E\_MIN: Channel lower energy boundary in keV
- E\_MAX: Channel upper energy boundary in keV
- The EBOUNDS extension contains:
- CHANNEL is the channel number.
- E\_MIN is the energy in keV corresponding to the start of the channel.
- E\_MAX is the energy in keV corresponding to the stop of the channel.

### 6.8.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	MATRIX	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	CHANNEL	J	-
	E_MIN	E	keV
	E_MAX	E	keV
2	BINTABLE	EBOUNDS	
	ENERG_LO	E	keV
	ENERG_HI	E	keV
	N_GRP	I	-
	F_CHAN	J	-
	N_CHAN	J	-
	MATRIX	45E	-

Table 6.17 - Response Matrix Calibration File Format

#### 6.8.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

#### 6.8.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'CPF'	'Dataset is Basic Calibration File
CCNM0001	'EBOUNDS'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CBD10001	'PIXEL(N)'	'Parameter boundary
CBD20001	'DETCANS(32768)'	'Parameter boundary

CBD30001	'FILTER(<string>)'	'Parameter boundary
CBD40001	'CHAN(0-32767)'	'Parameter boundary
CBD50001	'CHANTYPE("PI")'	'Parameter boundary
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CDES0001	'XRS Response Matrix generator by Monte Carlo code'	'Description
<b>Response Matrix File Keywords</b>		
EXTNAME	'EBOUNDS'	'Extension name
HUCLASS	'OGIP'	'Format conforms to OGIP standards
HUCLAS1	'RESPONSE'	'Extension contains response data
HUCLAS2	'EBOUNDS'	'Extension contains EBOUNDS
CHANTYPE	'PI'	'Channel type
DETCANS	32768	'Total number of detector channels

Table 6.17 - Response Matrix Calibration File Extension 1 Keyword

where <string> is set to OPEN.

#### 6.8.6 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'CPF'	'Dataset is a Calibration product File
CCNM0001	'MATRIX'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CBD10001	'PIXEL(N)'	'Parameter boundary
CBD20001	'DETCANS(32768)'	'Parameter boundary
CBD30001	'FILTER(<string>)'	'Parameter boundary
CBD40001	'CHAN(0 - 32767)'	'Parameter boundary

CBD50001	CHANTYPE("PI")	Parameter boundary
CVSD0001	"YYYY-MM-DD"	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRS Response Matrix'	Description
<b>Response Matrix File Keywords</b>		
EXTNAME	'MATRIX'	Extension name
HUCLASS	'OGIP'	Format conforms to OGIP standards
HUCLAS1	RESPONSE	Extension contains response data
HUCLAS2	RSP_MATRIX	Extension contains RMF
TLMIN4	0	First channel in the response
CHANTYPE	PI	Channel type
DETCANS	32768	Total number of detector channels

Table 6.18 - Response Matrix Calibration File Extension 1 Keywords

where <string> is for the OPEN filter.

## 7 XRT files format

### 7.1 Mirror Geometry Calibration File

#### 7.1.1 File Name

ae\_xrtl\_mirror\_YYYYMMDD.fits where l=0,3 to indicate the telescope units

ae\_xrts\_mirror\_YYYYMMDD.fits

#### 7.1.2 Description

The files describe the telescope mirror geometry. The file format consists of an empty primary header and two binary tables each with several columns.

#### 7.1.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	MIRROR	
	Column Names	Format	Units

	layer	J	-
	assembly	J	-
	number	J	-
	fragmnet	J	-
	function	J	-
	scatter	J	-
	freflect	SA	-
	breflect	SA	-
	fstart	D	rad
	fend	D	rad
	topinr	D	mm
	topoutr	D	mm
	botinr	D	mm
	botoutr	D	mm
	topd	D	mm
	botd	D	mm
	scross	L	-
	ecross	L	-
2	BINTABLE	OBSTRUCT	
	layer	J	-
	polynum	J	-
	distance	D	mm
	xvertex	D	-
	yvertex	D	-

Table 7.1- Mirror geometry Calibration File Format

#### 7.1.4 Primary Header Keywords

All keywords of Table 3.1 relevant for this instrument are mandatory.

#### 7.1.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GEOMETRY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CBD1001	'ENERG(0.1-30.0)'	Parameter boundary
CBD2001	'GEOMETRY(MIRROR)'	Parameter boundary
EXTNAME	'MIRROR'	Name of the binary table extension
<b>XRTS File Keywords</b>		
CDES0001	'SUZAKU XRT-S Mirror Geometry description'	Description
INSTRUME	'XRT-S'	Instrument name
<b>XRT&lt;I&gt; Files Keywords</b>		
CDES0001	'SUZAKU XRT-I Mirror Geometry description'	Description
INSTRUME	'XRT-<I>'	Instrument name

Table 7.2– Mirror geometry File Extension 1 Keywords

where <I> range from 0-3.

### 7.1.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'SHADOW'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used

CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CBD1001	'ENERG(0.1-30.0)'	Parameter boundary
CBD2001	'GEOMETRY(SHADOW)'	Parameter boundary
EXTNAME	'OBSTRUCT'	Name of the binary table extension
<b>XRTS File Keywords</b>		
CDES0001	'SUZAKU XRT-S shadow Geometry description'	Description
INSTRUME	'XRT-S'	Instrument name
<b>XRT&lt;I&gt; Files Keywords</b>		
CDES0001	'SUZAKU XRT-I shadow Geometry description'	Description
INSTRUME	'XRT-<I>'	Instrument name

Table 7.3 – Mirror geometry File Extension 2 Keywords

where <I> range from 0-3.

## 7.2 Pre-Collimator Geometry Calibration File

### 7.2.1 File Name

ae\_xrtl\_pcol\_YYYYMMDD.fits where I=0,3 to indicate the telescope units

ae\_xrts\_pcol\_YYYYMMDD.fits

### 7.2.2 Description

There are two types of telescopes on board of Suzaku with different focal length. The XRT-I is used in conjunction with the XIS detectors and the XRT-S with the XRS. The pre-collimator information is reported in separate files one for each of the telescope units two files. The file format consists of an empty primary header and a binary table with several columns.

### 7.2.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	EFFAREA	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	layer	J	-
	assembly	J	-
	number	J	-

fragmnet	J	-
function	J	-
scatter	J	-
frelect	SA	-
brelect	SA	-
fstart	D	rad
fend	D	rad
topinr	D	mm
topoutr	D	mm
botinr	D	mm
botoutr	D	mm
topd	D	mm
botd	D	mm
scross	L	-
ecross	L	-

Table 7.4 – Pre-collimator Calibration File Format

### 7.2.4 Primary Header Keywords

All keywords of Table 3.1 relevant for this instrument are mandatory.

### 7.2.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'GEOMETRY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used

CBD1001	'ENERG(0.1-30.0)'	Parameter boundary
CBD2001	'GEOMETRY(PRECOL)'	Parameter boundary
EXTNAME	'COLLIMATOR'	Name of the binary table extension
<b>XRTS File Keywords</b>		
CDES0001	'SUZAKU XRT-S pre-collimator Geometry description'	Description
INSTRUME	'XRT-S'	Instrument name
<b>XRT-&lt;I&gt; Files Keywords</b>		
CDES0001	'SUZAKU XRT-I pre-collimator description'	Description
INSTRUME	'XRT-<I>'	Instrument name

Table 7.5 - Precollimator File Extension 1 Keywords

where <I> range from 0-3.

## 7.3 Thermal Shield Transmission Calibration File

### 7.3.1 File Name

ae\_xtra\_shield\_YYYYMMDD.fits

### 7.3.2 Description

The file describes the thermal shield transmission based on ground measurements for the XRT-I and XRT-S telescopes. The file format consists of an empty primary header and a binary table that gives for a given energy a transmission value.

### 7.3.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	FTRANS	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	E	keV
	TRANSMIS	E	-

Table 7.6– Thermal shield Calibration File Format

### 7.3.4 Primary Header Keywords

All keywords of Table 3.1 relevant for this instrument are mandatory.

### 7.3.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'FTRANS'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDB1001	'ENERG(0.1-16.4)'	Parameter boundary
CDES0001	'XRT Thermal Shield Transmission'	Description
<b>Precollimator File Keywords</b>		
EXTNAME	'FTRANS'	Name of the binary table extension

Table 7.7 – Thermal shield File Extension 1 Keywords

## 7.4 Mirror Reflectivity Calibration File

### 7.4.1 File Name

ae\_xrta\_reflect\_YYYYMMDD.fits

### 7.4.2 Description

This file contains information on the mirror reflectivity. The file format consists in an empty primary header and three extensions. The three extensions have an identical format are reporting information for the front, back and collimator mirror.

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	AEFRONT	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	D	keV
	REFPROB	4000D	
2	BINTABLE	AEBACK	

Extension N.	Type	Ext. Name	
3	ENERGY	D	keV
	REFPROB	4000D	-
	BINTABLE	AECOL	
	ENERGY	D	keV
	REFPROB	4000D	-

Table 7.8 – Mirror reflectivity Calibration Files Format

### 7.4.3 Primary Header Keywords

All header keywords of Table 3.1 applicable to this instrument are mandatory.

### 7.4.4 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'REFLECTIVITY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRT mirror foil front surface reflectivity'	Description
CBD10001	'SURFACE(FRONT)'	Parameter boundaries
CDB20001	'FORMAT_VERSION(2)'	Parameter boundaries
<b>Reflectivity Files Keywords</b>		
EXTNAME	'AEFRONT'	Name of the binary table extension
FORMULA	'Au'	Surface formula
DENSITY	1.93e1	Surface cgs density
ROUGH	4.59	Surface roughness parameter

ICRPX2	1	Reference pixel in axis1
ICRVL2	0.0	Angle at reference pixel
ICDLT2	1.74532e-2	Increment per pixel
ICUNI2	'rad'	physical unit of pixel

Table 7.9 – Reflectivity Files Extension 1 Keywords

where the index j identifies different energy bin.

#### 7.4.5 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'REFLECTIVITY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRT mirror foil back surface reflectivity'	Description
CBD10001	'SURFACE(BACK)'	Parameter boundaries
CDB20001	'FORMAT_VERSION(2)'	Parameter boundaries
<b>Reflectivity Files Keywords</b>		
EXTNAME	'AEFront'	Name of the binary table extension
FORMULA	'A1'	Surface formula
DENSITY	2.69	Surface cgs density
ROUGH	80	Surface roughness parameter
ICRPX2	1	Reference pixel in axis1
ICRVL2	0.0	Angle at reference pixel
ICDLT2	1.74532e-2	Increment per pixel
ICUNI2	'rad'	physical unit of pixel

Table 7.10 – Reflectivity Files Extension 2 Keywords

where the index j identifies different bin.

#### 7.4.6 Extension 3 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'REFLECTIVITY'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRT mirror foil back surface reflectivity'	Description
CBD10001	'SURFACE(COLLIMATOR)'	Parameter boundaries
CDB20001	'FORMAT_VERSION(2)'	Parameter boundaries
<b>Reflectivity Files Keywords</b>		
EXTNAME	'AECOL'	Name of the binary table extension
FORMULA	'A1'	Surface formula
DENSITY	2.69	Surface cgs density
ROUGH	80	Surface roughness parameter
ICRPX2	1	Reference pixel in axis1
ICRVL2	0.0	Angle at reference pixel
ICDLT2	1.74532e-2	Increment per pixel
ICUNI2	'rad'	physical unit of pixel

Table 7.11 – Reflectivity Files Extension 1 Keywords

## 7.5 Backside profile Calibration File

### 7.5.1 File Name

ae\_xrta\_backprof\_YYYYMMDD.fits



## 7.5.2 Description

This file contains information on the backside profile of the mirror. The file format consists in an empty primary header and one extension.

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	BACKPROF	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	D	keV
	IntensityJ_Kdeg	jD	

Table 7.12 – Backside Calibration Files Format

The file contains 34 columns and J and K represent the angle and the decimal on the angle starting from the value of 0.0 (J=0 K=0). The values of J and K for columns from 2 to 22 increase by 0.1 deg up to 2 deg (J=2 K=0). The number of elements j for these columns starts in column 2 with 41 and increase by one up to column 22 where last value is 65. The values of J and K for columns from 23 to 30 increase by 0.2 deg up to 3.6 deg (J=3 K=6). The number of elements j for these columns starts with 62 for column 3 and increases by 2 or 3 alternate up to 84 in column 30. The values of J and K for columns from 31 to 33 increase by 0.4 deg up to 4.8 deg (J=4 K=8). The number of elements j for these columns starts is 89 for column 31, 93 for 32 and 98 for 33. Column 34 has J=5 and K=0 and j=101.

### 7.5.3 Primary Header Keywords

All header keywords of Table 3.1 applicable to this instrument are mandatory.

### 7.5.4 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'BACPROF'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
CDES0001	'XRT mirror foil front backside profile'	Description
CDB10001	'FORMAT_VERSION(2)'	Parameter boundaries

Reflectivity Files Keywords

EXTNAME	'BACKPROF'	Name of the binary table extension
ICRPXn	l	Reference pixel in axis1
ICRVLn	xx	Diffangle at reference pixel
ICDLTn	5.0	Increment per pixel
ICUNIn	'arcmin'	physical unit of pixel

Table 7.13 – Backsite Files Extension 1 Keywords

where the index 'n' is the index associated with the array columns and ranges from 2 to 34. 'xx' is the reference value for the diffraction angle that label the pixel in the array. For columns from 2 to 22 the reference value is derived from the following relation  $[2.5-(n-2)*6]$ . Therefore for column 2 the reference value is 2.5 and jump to -3.5 for column 3 and so on till the value of -117.5 for column 22. From columns 23 till 30, the reference value is derived using the relation  $[-117.5-(n-22)*12]$ . So columns 23 and 30 have -129.5 and -213.5 as reference value respectively. From columns 31 till 33, the reference value is derived using the relation  $[-213.5-(n-30)*24]$ . So columns 31 and 33 have -237.5 and -285.5 as reference value respectively. Last column, 34, has -297.5 as reference value.

## 7.6 Effective area

### 7.6.1 File Name

ae\_xrtl\_effarea\_YYYYMMDD.fits where I=0,3 to indicate the telescope units

### 7.6.2 Description

The files describe the telescope on-axis and off-axis effective area as function of energy. The file format consists of an empty primary header and two binary tables. The first extension contains the on-axis information, the second extension contains the off-axis information.

### 7.6.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	XRT<i></i>_ON-AXIS_EFFAREA	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	Theta	E	arcmin
	Effarea	nE	cm**2
2	BINTABLE	XRT<i></i>_OFF-AXIS_EFFAREA	
	Theta	E	arcmin
	Effarea_phi0	nE	cm**2
	Effarea_phi45	nE	cm**2

Effarea_phi90	nE	cm**2
Effarea_phi135	nE	cm**2

Table 7.14– Effective area Calibration File Format

where <I> range from 0-3.

#### 7.6.4 Primary Header Keywords

All keywords of Table 3.1 relevant for this instrument are mandatory.

#### 7.6.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'ON-AXIS_EFFAREA'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CBD1001	'THETA(0.0)arcmin'	'Parameter boundary
CBD2001	'PHI(0.0)deg'	'Parameter boundary
EXTNAME	'XRTI<i>_ON-AXIS_EFFAREA'	'Name of the binary table extension
ICRPIX2	1.	'Reference pixel in axis1
ICRVAL2	200.00	'Energy[eV] at reference pixel
ICDLT2	1.00E+00	'Increment per pixel
ICUNI2	'eV'	'physical unit of axis1
<b>XRT&lt;I&gt; Files Keywords</b>		
CDES0001	'XRT-I<i> on-axis area effective'	'Description
INSTRUME	'XRT-I<i>'	'Instrument name

Table 7.15– Effective area File Extension 1 Keywords

where <i> range from 0-3.

#### 7.6.6 Extension 2 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	'Dataset is Basic Calibration File
CCNM0001	'OFF-AXIS_EFFAREA'	'Type of calibration data
CDTP0001	'DATA'	'Calibration file contains data
CVSD0001	'YYYY-MM-DD'	'UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	'UTC time when calibration should first be used
CBD1001	'THETA(0.5-15.0)arcmin'	'Parameter boundary
CBD2001	'PHI(0.45-15.0)arcmin'	'Parameter boundary
EXTNAME	'XRTI<i>_OFF-AXIS_EFFAREA'	'Name of the binary table extension
ICRPIXn	1.	'Reference pixel in axis1
ICRVALn	200.00	'Energy[eV] at reference pixel
ICDLTn	1.00E+00	'Increment per pixel
ICUNIn	'eV'	'physical unit of axis1
<b>XRT&lt;I&gt; Files Keywords</b>		
CDES0001	'XRT-I<i> off-axis effective area at different positions'	'Description
INSTRUME	'XRT-I<i>'	'Instrument name

Table 7.16 – Effective area File Extension 2 Keywords

where <i> range from 0-3 and <n> reference to the columns from 2-5 .

#### 7.7 PSF

##### 7.7.1 File Name

ae\_xrtl\_psf\_YYYYMMDD.fits where I=0,3 to indicate the telescope units

##### 7.7.2 Description

The files contain a library of images describing the Point Spread Function at different energy offaxis and azimuth. The file format consists of an empty primary header and a binary table.

### 7.7.3 File Format

Extension N.	Type	Ext. Name	
0	PRIMARY		
1	BINTABLE	XRT-I<i>_PSF	
	<b>Column Names</b>	<b>Format</b>	<b>Units</b>
	ENERGY	E	keV
	OFF_AXIS	E	arcmin
	AZIMUTH	E	deg
	IMAGE	nI	-

Table 7.17-PSF Calibration File Format

where <i> range from 0-3.

### 7.7.4 Primary Header Keywords

All keywords of Table 3.1 relevant for this instrument are mandatory.

### 7.7.5 Extension 1 - Header Keywords

All keywords listed in Table 3.1 and Table 3.2 should be included in the header for this HDU. Specific settings of some of the CALDB keywords and others relevant to this file are listed below.

Keyword name	Keyword value	Comment
Table 3.1 & 3.2 - Mandatory header keywords		
<b>CALDB and other Keywords</b>		
CCLS0001	'BCF'	Dataset is Basic Calibration File
CCNM0001	'IMAGE_PSF'	Type of calibration data
CDTP0001	'DATA'	Calibration file contains data
CVSD0001	'YYYY-MM-DD'	UTC date when calibration should first be used
CVST0001	'hh:mm:ss'	UTC time when calibration should first be used
TDIM4	'(1536,1536)'	Parameter boundary
EXTNAME	'XRT-I<i>_PSF'	Name of the binary table extension
ICTYP4	' '	Projection used in axis1
ICRPIX4	768.5	Reference pixel in axis1
ICDLT4	0.0002895	Increment per pixel
ICUNI4	'deg'	physical unit of axis1

2CTYP4	' '	Projection used in axis2
2CRPIX4	768.5	Reference pixel in axis2
2CDLT4	0.0002895	Increment per pixe2
2CUNI4	'deg'	physical unit of axis2
<b>XRT&lt;I&gt; Files Keywords</b>		
CDES0001	'XRT-I<i> PSF for different energy and positions'	Description
INSTRUME	'XRT-I<i>'	Instrument name

Table 7.18- PSF File Extension 1 Keywords

where <i> range from 0-3.