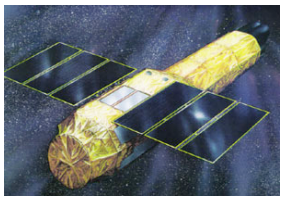

Suzaku

DESCRIPTION OF THE SUZAKU CALIBRATION FILES

Version 2.0

DATE Jun 30, 2011

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CHANGE RECORD PAGE (1 of 2)

DOCUMENT TITLE Requirements Document DOCUMENT DATE:			
ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Version 0.8	6 June 2005	all	First realese
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
Version 1.3	21 July 2006	all	Several changes. Main in theXRT section Note the PSF and Effective area will change format not yet included here
Version 1.4	April 2007	all	Includes new HXD file , burstid and ght . Upadte the HXD response description
Version 1.5	May 2007	all	Include the CI extension in the XIS for makepi, quanteff, rmfparam,ucodelist
Verison 1.6	May 2007	many	Aligned the format with the final release of the files
Version 1.7	Sep 2007	HXD rsp	Change names and CDB keywords in rsp
Version 1.8	Apr 2009	XIS	Added new calibration file light leak
Version 1.9	Sep 2010	WAM	Added the name spécification for the WAM subunits
Version 2.0	Jun 2011	XRT	Change the format of the XRT effective area and PSF to reflect the formats of the delivered files

Table of Contents

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 : ‘xrta’ 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 see HXD responses), 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

Datatype	*Cal directory*	*Used in pipeline*	*Description*
HXD			
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
gsoghf/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
pinflat	cpf	no	Full response matrices for simulate the PIN background
bstdid	bcf	no	Record the Burst ID and list all the trigger detected with the WAM
gsoght	bcf	no	Gain History file for the WELL_GSO
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.
ucode	bcf	no	Bits Code assigned for a mode. One file per XIS unit.
rmf*	cpf		Response matrices. One file per XIS unit.
hxdnom (2,4,6)	cpf		ARF with a HXD nominal pointing. One file per radius
xisnom (2,4,6) **	cpf		ARFwith an on-axis XIS nominal pointing. One file per XIS unit and radius.
contami	bcf		Coefficients of the curve of growth that describes the optical blocking filter contamination
llebndry	bcf		Light leak boundary
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.

** The ‘arf ‘ for the XIS were named ‘onaxis’ in the first version of the calibration data release.

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 *Applicable only for the HXD and XRS*
FILTER	<filter>	/Filter keyword *Applicable only to the XRS and omitted from the primary header*
DATE	YYYY-MM-DDThh:mm:ss	/Creation Date *This keyword is omitted from **empty** primary headers.*
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 *This keyword is omitted for data in the primary header*
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
CALDB Keywords		
CCLSxxxx	OGIP-class of calibration file	/Dataset is a Calibration Product File /Dataset is a Basic Calibration File *The comment depends on the datatype see sect 2.1*
CDTP*xxxx*	<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 *(Only when applicable)*
HDUDOC	<document number>	/Document describing the format *(Only when applicable)*
HDUCLAS*n*	<character string to classify the extension	/(Specific to the type) *(Only when applicable)*
HDUVERS*n*	<string giving the format version>	/Version of file format *(Only when applicable)*

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)
	HXD	
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 all the WAM sub-units
	WAM_ANTI0	The string WAM_ANTI0 is used in files that record data from the WAM sub-unit 0

	WAM_ANTI1	The string WAM_ANTI1 is used in files that record data from the WAM sub-unit 1
	WAM_ANTI2	The string WAM_ANTI2 is used in files that record data from the WAM sub-unit 2
	WAM_ANTI3	The string WAM_ANTI3 is used in files that record data from the WAM sub-unit 3

Keyword Name	Keyword String	Explanation (not FITS comment)
	XIS	
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
Keyword Name	Keyword String	Explanation (not FITS comment)
	XRS	
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.

Keyword Name	Keyword String	Explanation (not FITS comment)
		XRT
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	
	Column Names	**Format**	**Units**
	DETECTOR	8A	-
	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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'TELDEF'	/Type of calibration data
CDTP0001	'DATA'	/Calibration file contains data
CBD10001	‘FORMAT_VERSION(1)’	/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	'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		
CALDB Keywords		
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
Teldef Files Keywords		
EXTNAME	'HXD_ALIGNMENT'	/Name of the binary table extension

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	
	Column Names	**Format**	**Units**
	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

Extension N.	*Type*	*Ext. Name*	
	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	-
	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		
CALDB Keywords		
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

Linearization Keywords		
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		
CALDB Keywords		
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
Linearization Keywords		
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

Extension N.	*Type*	*Ext. Name*	
0	PRIMARY		
1	BINTABLE	ADCDNL	
	Column Names	**Format**	**Units**
	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
	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		
CALDB Keywords		
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	‘GSO differential non-linearity correction table (for hxdpi)’	/Description
Linearization Keywords		
EXTNAME	'ADCDNL’	/Name of the binary table extension
DETNAM	‘WELL_GSO’	/Detector name

Table 4.7 – Linearization GSO Calibration Files Extension 1 Keywords

NOTE : The description of the CDES001 changed from the first delivery to the second delivery. This was “Differential Non Linearity of SLOW and FAST ADC”

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		
CALDB Keywords		
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	‘GSO integrated non linearity correction table (hxdpi) ’	/Description
Linearization Keywords		
EXTNAME	'ADCINL’	/Name of the binary table extension
DETNAM	‘WELL_GSO’	/Detector name

Table 4.8 – Linearization GSO Calibration Files Extension 2 Keywords

NOTE : The description of the CDES001 changed from the first delivery to the second delivery. This was “Integrated Non Linearity of SLOW and FAST ADC”

4.4 Rebin setting Calibration File

4.4.1 File Name

ae_hxd_wampht_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	
	Column Names	**Format**	**Units**
	TABLE_ID	B	-
	TRN_BIN<i>	B	-
	ADD_FLG<j>	X	-

Table 4.9 – Rebin Calibration Files Format

Where <i> 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		
CALDB Keywords		
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
Rebin Files Keywords		
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_gsopsd_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	
	Column Names	**Format**	**Units**
	UNIT_ID	B	-
	RPI_F	D	chan
	RPI_S_CEN	D	chan
	RPI_S_UP	D	chan
	RPI_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		
CALDB Keywords		
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	
	Column Names	**Format**	**Units**
	ANGLE	D	arcmin
	SPECRESP	512D	cm**2

Extension N.	*Type*	*Ext. Name*	
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		
CALDB Keywords		
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
Arf Files Keywords		
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		
CALDB Keywords		
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 energy Channel'	/Description
Arf Files Keywords		
EXTNAME	'ART_ENERGIES'	/Name of the binary table extension
DETNAM	<detname>	/Detector name

Table 4.15 – Arf libray 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	
	Column Names	**Format**	**Units**
	UNIT_ID	B	-
	THRES_PIN0	D	chan
	THRES_PIN1	D	chan
	THRES_PIN2	D	chan

Extension N.	*Type*	*Ext. Name*	
	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		
CALDB Keywords		
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 lower threshold table (for hxdgrade)'	/Description
Threshold Files Keywords		
EXTNAME	'PINTHRES'	/Name of the binary table extension
DETNAM	'WELL_PIN'	/Detector name

Table 4.17 – Threshold Calibration Files Extension 1 Keyword

NOTE: The description of the CDES001 changed from the first delivery to the second delivery. This was "PIN PI threshold in hxdgrade".

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	
	Column Names	**Format**	**Units**
	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	
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	
	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	

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, 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		
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	‘Fit Results of the intrinsic Gd line on 348 keV.’	/Description
CDB0001	‘ENERG(348,348)’	/Parameter boundaries
Gain Files Keywords		
EXTNAME	'GSO_152GD_350KEV’	/Name of the binary table extension
DETNAM	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		
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	'Fit Results of the Annihilation line on 511 keV.'	/Description
CDB0001	'ENERG(511,511)'	/Parameter boundaries
Gain Files Keywords		
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		
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	‘Fit Results of the line from 153Gd line on 152 keV.’	/Description
CDB0001	‘ENERG(148,148)’	/Parameter boundaries
Gain Files Keywords		
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	
	Column Names	**Format**	**Units**
	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	

Extension N.	*Type*	*Ext. Name*	
	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, 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		
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_GHF’	/Name of the binary table extension
DETNAM	‘WELL_PIN’	/Detector name

Table 4.23 – PIN Gain Calibration Files Extension 1 Keywor

4.10 Response Matrices

4.10.1 File Name

The response files changed name twice, in August 2006 and September 2007, and additional boundary keywords were added. This was done to cope with changes in the HXD PIN detector. This section reports the old and the new conversion for the response files that are stored in the CALDB. The sections ID with “2007 convention” and “2006 convention” describe for the new and old convention respectively. The original convention adopted before august 2006 is reported as pre-august 2006.

2007 convention

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

ae_hxd_gso<xxxxx>_YYYYMMDD.rsp ae_hxd_pin<xxxxxzz>_YYYYMMDD.rsp

where <xxxxx> is either 'xinom' or 'hxnom' depending if the pointing position was for the XIS or HXD nominal respectively and 'zz' identifies the different epoch and identify periods when there was a change in the detector performace.

There are also response matrix created to estimate the PIN cosmic background. The file name convention is the following :

ae_hxd_pinflat<zz>_YYYYMMDD.rsp

where <zz> identify the epoch similarly to the PIN responses. The responses have been issued for the following start date of validity

<zz>	Start of validity
E1	2005-08-17
E2	2006-07-27
E3	2006-10-3
E4	2007-07-28

Old Convention

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

ae_hxd_gso<xxxxx>_YYYYMMDD.rsp ae_hxd_pin<xxxxxx>_YYYYMMDD.rsp

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

There are also response matrix created to estimate the PIN cosmic background. The file name convention is the following :

ae_hxd_pinflat_YYYYMMDD.rsp

The above filename are in use when the instrument is fully working. After May 2006 the PIN had the high tensions reduced in two of the 4 groups of counters in the WELL . The string that describes the data type is changed and uses up to 11 characters. The new naming convention is the following way :

ae_hxd_pin<xxxxxxx>_YYYYMMDD.rsp

where the string 'pinxxxxxxx' is set as follows :

	Full Pin	PIN 123 (From May 24, 2006)	PIN 23 (after Oct 3, 2006)
HXD nominal position	pinhxnom	pinhxnom123	pinhxnom23
XIS nominal position	pinxinom	pinxinom123	pinxinom23
Pin Background	pinflat	pinflat123	pinflat23

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.

4.10.2 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
	Column Names	**Format**	**Units**
1	BINTABLE	MATRIX	
	ENERG_LO	E	KeV
	ENERG_HI	E	KeV
	N_GRP	I	-
	F_CHAN	I	-
	N_CHAN	I	-
	MATRIX	<ii>E	-
2	BINTABLE	EBOUNDS	
	Column Names	**Format**	**Units**
	CHANNEL	I	Chan
	E_MIN	E	KeV
	E_MAX	E	KeV

Table 4.24 - Response Matrix Calibration File Format

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

4.10.3 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

4.10.4 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.

Pre-August 2006

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
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	‘RESPONSE’	/Extension contains response data
HDUCLAS2	‘RSP_MATRIX’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Response Matrix PIN File Keywords		
CCBD10001	CBD10001	CBD10001
CHANTYPE	CHANTYPE	CHANTYPE
DETCHANS	DETCHANS	DETCHANS
DETNAM	DETNAM	DETNAM
Response Matrix GSO File Keywords		
CBD10001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	PI_SLOW	/Channel type
DETCHANS	512	/Total number of detector channels
DETNAM	WELL_GSO	/Detector name

Table 4.25 - Response Matrix Calibration File Extension 1 Keywords

where <iiii> is HXDNOM or XISNOM to indicate if the nominal pointing is for the HXD or XIS .

NOTE the above keywords setting was used for the first delivery of the response matrices. In the second delivery the many of the keywords changed. The new keywords header are listed in the table 4.25a. The content of the 4.25 is considered obsolete.

2006 convention

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
EXTNAME	'MATRIX'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	‘RESPONSE’	/Extension contains response data
HDUCLAS2	‘RSP_MATRIX’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Response Matrix PIN File Keywords		
CDES0001	‘PIN energy response matrix at XXX nominal (RESPONSE MATRIX)	/Description
CBD10001	'ENERG(0.1875-96.1875)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	PI_PIN	/Channel type
DETCHANS	256	/Total number of detector channels
DETNAM	WELL_PIN	/Detector name
Response Matrix GSO File Keywords		
CDES0001	‘GSO energy response matrix at XXX nominal (RESPONSE MATRIX)	/Description
CBD10001	'ENERG(0.0-1024.0)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	PI_SLOW	/Channel type
DETCHANS	512	/Total number of detector channels

DETNAM	WELL_GSO	/Detector name

Table 4.25a - Response Matrix Calibration File Extension 1 Keywords

where XXX is set to HXD if iiii is set to HXDNOM to indicate that the response is valid for HXD nominal pointing position and to XIS if iiii is indicate that the response is valid for XIS nominal pointing position. The values for <iiiii> are the following:

HXDNOM or XISNOM to indicate if the nominal pointing is for the HXD or XIS and if the full PIN detector is in use. NOTE that in old responses there is the usage of ONXIS **only** for the XIS nominal (in responses delivered after Nov 2005 this was changed to XISNOM) .

HXDNOM123 or XISNOM123 to indicate if the nominal pointing is for HXD or XIS and if the PIN units are 123

HXDNOM23 or XISNOM23 to indicate if the nominal pointing is for the HXD or XIS and if the PIN units are 23

2007 convention

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
EXTNAME	'MATRIX'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	‘RESPONSE’	/Extension contains response data
HDUCLAS2	‘RSP_MATRIX’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Response Matrix PIN File Keywords		
CDES0001	‘PIN energy response matrix at XXX nominal (RESPONSE MATRIX)	/Description
CBD10001	'ENERG(0.1875-96.1875)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CBD30001	PINHV_W0(val)	/Parameter boundary
CBD40001	PINHV_W1(val)	/Parameter boundary
CBD50001	PINHV_W2(val)	/Parameter boundary

CBD60001	PINHV_W3(val)	/Parameter boundary
CBD70001	PINTHR(date)	/Parameter boundary
CHANTYPE	PI_PIN	/Channel type
DETCHANS	256	/Total number of detector channels
DETNAM	WELL_PIN	/Detector name
Response Matrix GSO File Keywords		
CDES0001	‘GSO energy response matrix at XXX nominal (RESPONSE MATRIX)	/Description
CBD10001	'ENERG(0.0-1024.0)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	PI_SLOW	/Channel type
DETCHANS	512	/Total number of detector channels
DETNAM	WELL_GSO	/Detector name

Table 4.25c - Response Matrix Calibration File Extension 1 Keywords

where ‘val’ is the value of the voltage setting for Wx detector component, ‘date’ is the release date of threshold file that was used to generate the response and iiii is set to HXDNOM or to XISNOM to indicate if the nominal pointing is for the HXD or XIS and if the full PIN detector is in use. For the flat response matrices iiii is set to FLAT.

4.10.5 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.

Pre-August 2006

Keyword name	**Keyword value**	**Comment**
Table 3.1 & 3.2 - Mandatory header keywords		
CALDB Keywords		
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
HDUCLASS	'OGIP'	/Format conforms to OGIP standards

HDUCLAS1	‘RESPONSE’	/Extension contains response data
HDUCLAS2	‘EBOUNDS’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Ebounds PIN File Keywords		
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	‘PI_PIN’	/Channel type
DETCHANS	256	/Total number of detector channels
DETNAM	WELL_PIN	/Detector name
Ebounds GSO File Keywords		
CBD10001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	‘PI_SLOW’	/Channel type
DETCHANS	512	/Total number of detector channels
DETNAM	WELL_GSO	/Detector name

Table 4.26a – 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.

NOTE the above keywords setting was used for the first delivery of the response matrices. In the second delivery the many of the keywords changed. The new keywords header are listed in the table 4.26a. The content of the 4.26a is considered obsolete.

2006 convention

Keyword name	**Keyword value**	**Comment**
Table 3.1 & 3.2 - Mandatory header keywords		
CALDB Keywords		
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
EXTNAME	'EBOUNDS'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	‘RESPONSE’	/Extension contains response data

HDUCLAS2	‘EBOUNDS’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Ebounds PIN File Keywords		
CDES0001	'PIN energy response matrix at XXX nominal (EBOUNDS)’	/Description
CBD10001	'ENERG(0.1875-96.1875)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	‘PI_PIN’	/Channel type
DETCHANS	256	/Total number of detector channels
DETNAM	WELL_PIN	/Detector name
Ebounds GSO File Keywords		
CDES0001	‘GSO energy response matrix at XXX nominal (EBOUNDS)’	/Description
CBD10001	'ENERG(0.0-1024.0)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	‘PI_SLOW’	/Channel type
DETCHANS	512	/Total number of detector channels
DETNAM	WELL_GSO	/Detector name

Table 4.26b – Response Matrix Calibration File Extension 2 Keyword

where XXX is set to HXD if iiii is set to HXDNOM to indicate that the response is valid for HXD nominal pointing position and to XIS if iiii is XISNOM to indicate that the response is valid for XIS nominal pointing position.

2006 convention

Keyword name	**Keyword value**	**Comment**
Table 3.1 & 3.2 - Mandatory header keywords		
CALDB Keywords		
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
EXTNAME	'EBOUNDS'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	‘RESPONSE’	/Extension contains response data
HDUCLAS2	‘EBOUNDS’	/Extension contains RMF
HDUCLAS3	‘FULL’	/Keyword information for Caltools Software
RMFVERSN	2005	OGIP classification of FITS format
Ebounds PIN File Keywords		
CDES0001	'PIN energy response matrix at XXX nominal (EBOUNDS)’	/Description
CBD10001	'ENERG(0.1875-96.1875)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CBD30001	PINHV_W0(val)	/Parameter boundary
CBD40001	PINHV_W1(val)	/Parameter boundary
CBD50001	PINHV_W2(val)	/Parameter boundary
CBD60001	PINHV_W3(val)	/Parameter boundary
CBD70001	PINTHR(date)	/Parameter boundary
CHANTYPE	‘PI_PIN’	/Channel type
DETCHANS	256	/Total number of detector channels
DETNAM	WELL_PIN	/Detector name
Ebounds GSO File Keywords		
CDES0001	‘GSO energy response matrix at XXX nominal (EBOUNDS)’	/Description
CBD10001	'ENERG(0.0-1024.0)keV'	/Parameter boundary
CBD20001	'POINTING(iiii)'	/Parameter boundary
CHANTYPE	‘PI_SLOW’	/Channel type
DETCHANS	512	/Total number of detector channels
DETNAM	WELL_GSO	/Detector name

Table 4.26c – Response Matrix Calibration File Extension 2 Keyword

where ‘val’ is the value of the voltage setting for Wx detector component, ‘date’ is the release date of threshold file that was used to generate the response and iiii is set to HXDNOM or to XISNOM to indicate if the nominal pointing is for the HXD or XIS and if the full PIN detector is in use. For the flat response matrices iiii is set to FLAT.

4.11 GSO Gain History Table Calibration File

4.11.1 File Name

ae_hxd_gsoght_YYYYMMDD.fits

4.11.2 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. This file is similar in format to the gain history file see section 4.8 but differ for some of the columns.

4.11.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
	Column Names	**Format**	**Units**
	BINTABLE	GHT_152GD_350KEV	
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	MODEL_ID	I	
	W<ij>_SLOW	8D	
	W<ij>_FAST	8D	
2	BINTABLE	GHT_ANNIHILATION_511KEV	
	START_TIME	D	s
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	MODEL_ID	I	
	W<ij>_SLOW	8D	
	W<ij>_FAST	8D	
3	BINTABLE	GHT_153GD_150KEV	
	START_TIME	D	s

Extension N.	*Type*	*Ext. Name*	
	YYYYMMDD	J	
	HHMMSS	J	
	END_TIME	D	s
	MODEL_ID	I	
	W<ij>_SLOW	8D	
	W<ij>_FAST	8D	

Table 4.27 – GSO Gain History Files Format

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

4.11.4 Primary Header Keywords

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

4.11.5 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'GAIN_HIST_PARAM'	/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 parameters of the intrinsic Gd line on 348 keV.’	/Description
CDB0001	‘ENERG(348,348)’	/Parameter boundaries
Gain Files Keywords		
EXTNAME	'GHT_152GD_350KEV’	/Name of the binary table extension
DETNAM	WELL_GSO	/Detector name

Table 4.28 – Gain GSO Calibration Files Extension 1 Keywords

4.11.6 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'GAIN_HIST_PARAM'	/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 parameters of the Annihilation line on 511 keV.’	/Description
CDB0001	‘ENERG(511,511)’	/Parameter boundaries
Gain Files Keywords		
EXTNAME	'GHT_ANNIHILATION_511KEV’	/Name of the binary table extension
DETNAM	WELL_GSO	/Detector name

Table 4.29 – Gain GSO Calibration Files Extension 1 Keywords

4.11.7 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'GAIN_HIST_PARAM'	/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 Parameters of the line from 153Gd line on 152 keV.’	/Description
CDB0001	‘ENERG(148,148)’	/Parameter boundaries
Gain Files Keywords		
EXTNAME	'GHT_153GD_150KEV’	/Name of the binary table extension
DETNAM	WELL_GSO	/Detector name

Table 4.30 – Gain GSO Calibration Files Extension 1 Keywords

4.12 WAM Burst ID Calibration File

4.12.1 File Name

ae_hxd_bstidt_YYYYMMDD.fits

4.12.2 Description

This file contains the burst ID. The column description is the following:

- TRG_ID : Trigger ID of HXD-WAM Burst data, which is sequentially given from the launch of Suzaku. This id is not automatically generated in the pipeline processing, and is also attached in a header of BST Fits file.
- BURST_ID': Trigger ID of HXD-WAM Burst data, which is automatically tagged in the pipe line processing. This id is originally generated from 'FRTM_CT0'_'OBSID' in BST FITS file. This id is also attached in each BST Fits file.
- TRN_ID: The flare-like event appears both in the HXD-WAM event FITS file and HXD-WAM BST FITS file. We also have an id for an event seen in a WAM FITS file just for convenience in our analyses. The 'TRN_ID' is the event ID in the HXD-WAM event FITS file, which corresponds to the BST event of interest. This id is not automatically generated in the pipe line processing, but determined by the HXD WAM team.
- YYYYMMDD and HHMMSS: The date and time when the event occurs. The HXD-WAM crystals are divided into four sides, HXD-WAM-0,1,2,3, and each side can, in principle, independently trigger the BST event. Thus, the values of date and time for each side is different with each other. The whole value of YYYYMMDD and HHMMSS are described in 'FRZN_YYYYMMDD' and 'FRZN_HHMMSS' in this bstidt.fits. The value of 'YYYYMMDD' and 'HHMMSS' are the same as the values of HXD-WAM-0.
- CLASSIFICATION : The classification of BST data, which is assigned by the HXD WAM team.
    - [0x00:unID, 0x01:confirmed gamma-ray burst,
    - 0x02:possible gamma-ray burst,
    - 0x03:solar flare,
    - 0x04:soft gamma-ray repeaters,
    - 0x05:particle event, 0x06:noise, 0x07:SAA,
    - 0x08:others, 0xFF:not classified yet]

- TRG_SRC and TRG_SRC_SOFT: The HXD-AE TPU-0,1,2,3 and HXD-DE software monitors HXD WAM unit(s) and can rigger an event of BST data. The 'TRG_SRC' is the trigger source, which electronics triggered to produce BST data. There are four algorithms in the in-orbit software of the HXD-DE to detect flare-like events in the light curves of the HXD-WAM. The 'TRG_SRC_SOFT' describes which mode triggers the event, and is valid when the value of 'TRG_SRC' is 0x01 (HXD DE software).

  TRG_SRC values :

  - [1:HXD-DE on-board software, 2:WAM-3, 3:WAM-2,
  - 4:WAM-1, 5:WAM-0]

  TRG_SRC_SOFT value:

  - [1:TPU Trigger Mode, 2:PH Monitor Mode,
  - 3:WANTI (Well Slow LD) Monitor Mode,
  - 4:Pseudo Mode]

- FRZN_YYYYMMDD, FRZN_HHMMSS and FRZN_AETIME : The date, time, and aetime of the event for four HXD-WAM sides. See descriptions in 'YYYYMMDD' and 'HHMMSS'.
- SIMUL_SA: Satellites simultaneously detected the event. See the comment above.The HXD-WAM team monitors the status of these satellites, and determine the value of 'SIMUL_SA'.
  - [0:nothing, 1:HETE-2, 2:Swift BAT, 3:Konus Wind, 4:Ulysses, 5:Messenger, 6:Mars Odyssey, 7:INTEGRAL SPI-ACS, 8:INTEGRAL IBIS, 9:AGILE, 10:GLAST, 11:Goes, 12:RHESSI, 13:Trace, 14:Hinode, 15-32:others reserved]. This information is provided by Interplanetary Network (Kevin Hurley, http://ssl.berkeley.edu/ipn3/index.html and http://heasarc.gsfc.nasa.gov/W3Browse/gamma-ray bursts/ipngrb.html.)
- PEAK_CNTRATE: Count rate of each side of the HXD-WAM at the peak flux.
  - (TH 0 to 3) without dead time correction,
  - [0:WAM-0, 1:WAM-1, 2:WAM-2, 3:WAM-3]
- EULER: Euler vector of the satellite when the event happens.
- INCI_THETA, INCI_PHI, INCI_RA, INCI_DEC, INCI_ORIGIN : The values of 'INCI_THETA' and 'INCI_PHI' are the incident angles of the irradiation of the object to the HXD WAM. The definition of theta and phi are described in the following URL http://www.astro.isas.jaxa.jp/suzaku/HXD-WAM/WAM-GRB/grb/trig/inter.html#position. The values of 'INCI_RA ' and 'INCI_DEC' are RA and DEC of the object. The information is taken from GCN, Atel, and other communications with the HXD-WAM team, and are summarized in 'INCI_ORIGIN'.
- SAT_ALT, SAT_LON, SAT_LAT: The position of the satellite when the event occurs.
- TIME_MODEL: The time setting of the HXD-AE TPU. TPU Time mode for WAM-n (n=0,1,2,3).
  [0x00:1/2 sec, 0x01:1 sec, 0x02:2 sec, 0x03:4 sec]
- FRZON_GBREAD, FRZON_AETIME, FRZON_TI, FROZON_T_LATCH_TI and FRZON_ACU_T_LATCH: HK values when the freeze process of BST data starts on the HXD-AE TPU. (values when FReeZe flag ON). The above columns correspond to 'HXD_GB_RD_CNT' in the 2nd extension of aeXXXXXhxd_0.hk , 'TIME ' in TRN event FITS, 'TI' in TRN event FITS,'HXD_TLATCH_TIME' in the 2nd extension of aeXXXXXhxd_0.hk, 'HXD_AE_TM_LATCH_TM' in the 1st extension of aeXXXXXhxd_0.hk, respectively.
- FRZOF_GBREAD, FRZOF_AETIME: HK values when the freeze process of BST data ends on the HXD-AE TPU. (values when FReeZe flag OFF). The values correspond to 'HXD_GB_RD_CNT' in the 2nd extension of aeXXXXXhxd_0.hk TIME ' in TRN event FITS, respectively.

- VALID_YYYYMMDD, VALID_HHMMSS, BSTID_REV: The date and time when the row is created or updated. If the updates occurs, 'BSTID_REV' for each row is incremented from 0.

4.12.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	GHT_152GD_350KEV	
	Column Names	**Format**	**Units**
	TRG_ID	J	
	BURST_ID	64A	
	TRN_ID	64A	
	YYYYMMDD	J	
	HHMMSS	J	
	CLASSIFICATION	J	
	TGR_SRC	5X	
	TGR_SRC_SOFT	4X	
	FRZN_YYYYMMDD	4J	
	FRZN_HHMMSS	4J	
	FRZN_AETIME	4D	s
	SIMUL_SA	32X	
	PEAK_CNT	4J	count/s
	EULER	3D	deg
	INCI_THETA	D	deg
	INCI_PHI	D	deg
	INCI_RA	D	deg
	INCI_DEC	D	deg
	INCI_ORIGIN	64A	
	SAT_ALT	1E	km
	SAT_LON	1E	deg
	SAT_LAT	1E	deg

Extension N.	*Type*	*Ext. Name*	
	TIME_MODE	4J	
	FRZON_GBREAD	J	
	FRZON_AETIME	4D	
	FRZON_TI	4J	
	FRZON_T_LATCH_TI	J	
	FRZON_ACU_T_LATCH	J	
	FRZOF_GBREAD	J	
	FRZOF_AETIME	4D	
	VALID_YYYYMMDD	J	
	VALID_HHMMSS	J	
	BSTID_REV	J	

Table 4.31 – WAM Burst ID Files Format

4.12.4 Primary Header Keywords

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

4.12.5 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'BURST_ID_TABLE'	/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	‘ID table of HXD_WAM Burst data’	/Description
Burstid Files Keywords		

EXTNAME	'BST_IDT'	/Name of the binary table extension
DETNAM	WAM_ANTI	/Detector name

Table 4.31 – WAM Burst ID Files Format

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_xiI_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		
CALDB Keywords		
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
Instrument keyword		
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_xiI_badcolum_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	
	Column Names	**Format**	**Units**
	START	D	s
	STOP	D	s
	SEGMENT	I	
	RAWX	I	pixel
	RAWY1	I	pixel
	RAWY2	I	pixel
	ACTX	I	pixel
	ACTY1	I	pixel

Extension N.	*Type*	*Ext. Name*	
	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_xiI_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_xiI_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 23 binary table extensions.

5.4.3 File Format

Extension N.	*Type*	*Ext. Name*	
0	PRIMARY		
1	BINTABLE	CHARGETRAIL	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	1024B	
	RAWX	1024B	
	TrailH	1024E	
	TrailV	1024E	
	AlphaH	1024E	
	AlphaV	1024E	
	OffsetRAWX	1024I	
	OffsetACTY	1024I	
2	BINTABLE	PARALLEL_CTI	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	1024B	
	RAWX	1024B	
	CTI_CONST	1024E	1/chan
	CTI_NORM	1024E	1/chan
	CTI_POW	1024E	
	CTIFS_NORM	1024E	1/chan
3	BINTABLE	SERIAL_CTI	
	Column Names	**Format**	**Units**
	Time	D	s

Extension N.	*Type*	*Ext. Name*	
	Segment	4B	
	CTI_CONST	4E	1/chan
	CTI_NORM	4E	1/chan
	CTI_POW	4E	
4	BINTABLE	SPTH_PARAM	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	4B	
	OFFSET	4E	chan
	SLOPE	4E	
	MINIMUM	4E	chan
5	BINTABLE	GAIN-AETEMP	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	4B	
	NORM	4E	
	OFFSET	4E	
	POW	4E	
6	BINTABLE	GAIN_NORMAL	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	4B	
	QUAD_LOW	4E	eV/chan**2
	LINR_LOW	4E	eV/chan
	OFFSET_LOW	4E	eV
	QUAD_HIGH	4E	eV/chan**2
	LINR_HIGH	4E	eV/chan
	OFFSET_HIGH	4E	eV
	Boundary_LM	4E	eV

Extension N.	*Type*	*Ext. Name*	
	Boundary_MH	4E	eV
	FWHM_LM	4E	eV
	FWHM_MH	4E	eV
	AETemp	4E	degC (not standard)
7	BINTABLE	GAIN_PSUM	
	Column Names	**Format**	**Units**
	Time	D	s
	Segment	4B	
	QUAD_LOW	4E	eV/chan**2
	LINR_LOW	4E	eV/chan
	OFFSET_LOW	4E	eV
	QUAD_HIGH	4E	eV/chan**2
	LINR_HIGH	4E	eV/chan
	OFFSET_HIGH	4E	eV
	Boundary_LM	4E	eV
	Boundary_MH	4E	eV
	FWHM_LM	4E	eV
	FWHM_MH	4E	eV
	AETemp	4E	degC (not standard)
8,9	BINTABLE	PARALLEL_CTI_4WI	
	BINTABLE	PARALLEL_CTI_8WI	
	Column Names	**Format**	**Units**
	Time	1D	s
	Segment	1024B	
	RAWX	1024B	
	CTI_CONST	1024E	1/chan
	CTI_NORM	1024E	1/chan
	CTI_POW	1024E	
	CTIFS_NORM	1024E	1/chan

Extension N.	*Type*	*Ext. Name*	
10,11,12	BINTABLE	PARALLEL_CTI_SCI	
	BINTABLE	PARALLEL_CTI_4WI	
	BINTABLE	PARALLEL_CTI_8WI	
	Column Names	**Format**	**Units**
	Time	D	s
	SCI_PERIOD_RAWY	I	
	Segment	1024B	
	RAWX	1024B	
	CTI_NORM_U	1024E	1/chan
	CTI_NORM_L	1024E	1/chan
	dQ_NORM	1024E	1/chan
	CTI_POW	1024E	
	CTIFS_NORM	1024E	1/chan
13-23	BINTABLE	GAIN_4WI	
	BINTABLE	GAIN_8WI	
	BINTABLE	GAIN_2x2	
	BINTABLE	GAIN_2x2_4WI	
	BINTABLE	GAIN_2x2_8WI	
	BINTABLE	GAIN_NORMAL_SCI	
	BINTABLE	GAIN_4WI_SCI	
	BINTABLE	GAIN_8WI_SCI	
	BINTABLE	GAIN_2x2_SCI	
	BINTABLE	GAIN_2x2_4WI_SCI	
	BINTABLE	GAIN_2x2_8WI_SCI	
	Column Names	**Format**	**Units**
	Tiime	1D	s
	Segment	4B	
	QUAD_LOW	4E	eV/chan**2
	LINR_LOW	4E	eV/chan**2

Extension N.	*Type*	*Ext. Name*	
	OFFSET_LOW	4E	eV/chan**2
	QUAD_MED	4E	eV/chan**2
	LINR_MED	4E	eV/chan**2
	OFFSET_MED	4E	eV/chan**2
	QUAD_HIGH	4E	eV/chan**2
	LINR_HIGH	4E	eV/chan**2
	OFFSET_HIGH	4E	eV/chan**2
	Boundary_LM	4E	eV
	Boundary_MH	4E	eV
	AETemp	4E	deg

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		
CALDB and Instrument keywords all extensions		
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 PI’	/Description
CDB1001	FORMAT_VERSION(1)	
INSTRUME	‘XIS<i>’	/Instrument name
Extension 1 CALDB keyword setting		

EXTNAME	‘CHARGETRAIL’	/Name of the binary table extension
CCNM0001	'CHARGETRAIL'	/Type of calibration data
Extension 2 CALDB keyword setting		
EXTNAME	‘PARALLEL_CTI’	/Name of the binary table extension
CCNM0001	'PARELLEL_CTI'	/Type of calibration data
Extension 3 CALDB keyword setting		
EXTNAME	‘SERIAL_CTI’	/Name of the binary table extension
CCNM0001	'SERIAL_CTI’	/Type of calibration data
Extension 4 CALDB keyword setting		
EXTNAME	‘SPTH_PARAM’	/Name of the binary table extension
CCNM0001	'SPTH_PARAM'	/Type of calibration data
Extension 5 CALDB keyword setting		
EXTNAME	‘GAIN-AETEMP’	/Name of the binary table extension
CCNM0001	'GAIN-AETEMP'	/Type of calibration data
Extension 6 CALDB keyword setting		
EXTNAME	‘GAIN_NORMAL’	/Name of the binary table extension
CCNM0001	'GAIN_NORMAL'	/Type of calibration data
Extension 7 CALDB keyword setting		
EXTNAME	‘GAIN_PSUM’	/Name of the binary table extension
CCNM0001	'GAIN_PSUM	/Type of calibration data
Extension 8.9 CALDB keyword setting		
EXTNAME	‘PARALLEL_CTI_4WI’	/Name of the binary table extension
	‘PARALLEL_CTI_8WI’	
CCNM0001	‘PARALLEL_CTI_4WI’	/Type of calibration data
	‘PARALLEL_CTI_8WI’	
Extension 10,11,12 CALDB keyword setting		
EXTNAME	‘PARALLEL_SCI’	/Name of the binary table extension
	‘PARALLEL_CTI_4WI’	
	‘PARALLEL_CTI_8WI’	
CCNM0001	‘PARALLEL_SCI’	/Type of calibration data
	‘PARALLEL_CTI_4WI’	

	‘PARALLEL_CTI_8WI’	
Extension 13-21 CALDB keyword setting		
EXTNAME	‘GAIN _4WI’	/Name of calibration data
	‘GAIN_8WI’	
	‘GAIN_2x2’	
	‘GAIN_4WI’	
	‘GAIN_8WI’	
	‘GAIN_NORMAL_SCI’	
	‘GAIN_4WI_SCI’	
	‘GAIN_8WI_SCI’	
	‘GAIN_2x2_SCI’	
	‘GAIN_2x2_4WI_SCI’	
	‘GAIN_2x2_8WI_SCI’	
EXTNAME	‘GAIN _4WI’	/Type of calibration
	‘GAIN_8WI’	
	‘GAIN_2x2’	
	‘GAIN_4WI’	
	‘GAIN_8WI’	
	‘GAIN_NORMAL_SCI’	
	‘GAIN_4WI_SCI’	
	‘GAIN_8WI_SCI’	
	‘GAIN_2x2_SCI’	
	‘GAIN_2x2_4WI_SCI’	
	‘GAIN_2x2_8WI_SCI’	

Table 5.8 – Charge transfer Calibration Files Extension 1-21 Keyword

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

5.4.6 File Format obsolete (previous version of the makpi)

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

Extension N.	*Type*	*Ext. Name*	
	Time	E	s
	Segment	PI(1024)	
	RAWX	PI(1024)	
	TrailH	PE(1024)	
	TrailV	PE(1024)	
	AlphaH	PE(1024)	
	AlphaV	PE(1024)	
	OffsetRAWX	PI(1024)	
	OffsetACTY	PI(1024)	
2	BINTABLE	PARALLEL_CTI	
	Column Names	**Format**	**Units**
	Time	E	s
	Segment	PI(1024)	
	RAWX	PI(1024)	
	CTI_CONST	PE(1024)	1/chan
	CTI_NORM	PE(1024)	1/chan
	CTI_POW	PE(1024)	
3	BINTABLE	SERIAL_CTI	
	Column Names	**Format**	**Units**
	Time	E	s
	Segment	PI(4)	
	CTI_CONST	PE(4)	1/chan
	CTI_NORM	PE(4)	1/chan
	CTI_POW	PE(4)	
4	BINTABLE	SPTH_PARAM	
	Column Names	**Format**	**Units**
	Time	E	s
	Segment	PI(4)	
	OFFSET	PE(4)	chan

Extension N.	*Type*	*Ext. Name*	
	SLOPE	PE(4)	
	MINIMUM	PI(4)	chan
5	BINTABLE	GAIN-AETEMP	
	Column Names	**Format**	**Units**
	Time	E	s
	Segment	PI(4)	
	NORM	PE(4)	
	OFFSET	PE(4)	
	POW	PE(4)	
6	BINTABLE	GAIN_NORMAL	
	Column Names	**Format**	**Units**
	Time	E	s
	Segment	PE(4)	
	QUAD_LOW	PE(4)	eV/chan**2
	LINR_LOW	PE(4)	eV/chan
	OFFSET_LOW	PE(4)	eV
	QUAD_HIGH	PE(4)	eV/chan**2
	LINR_HIGH	PE(4)	eV/chan
	OFFSET_HIGH	PE(4)	eV
	AETemp	PE(4)	
7	BINTABLE	GAIN_PSUM	
	Column Names	**Format**	**Units**
	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

Extension N.	*Type*	*Ext. Name*	
	OFFSET_HIGH	PI(4)	eV
	AETemp	PI(4)	

Table 5.7-old – Charge transfer Calibration Files Format

5.4.7 Primary Header Keywords

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

5.4.8 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		
CALDB and Instrument keywords all extensions		
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 PI’	/Description
INSTRUME	‘XIS<i>’	/Instrument name
Extension 1 CALDB keyword setting		
EXTNAME	‘CHARGETRAIL’	/Name of the binary table extension
CCNM0001	'CHARGETRAIL'	/Type of calibration data
Extension 2 CALDB keyword setting		
EXTNAME	‘PARALLEL_CTI’	/Name of the binary table extension
CCNM0001	'PARELLEL_CTI'	/Type of calibration data
Extension 3 CALDB keyword setting		
EXTNAME	‘SERIAL_CTI’	/Name of the binary table extension
CCNM0001	'SERIAL_CTI’	/Type of calibration data
Extension 4 CALDB keyword setting		

EXTNAME	‘SPTH_PARAM’	/Name of the binary table extension
CCNM0001	'SPTH_PARAM'	/Type of calibration data
Extension 5 CALDB keyword setting		
EXTNAME	‘GAIN-AETEMP’	/Name of the binary table extension
CCNM0001	'GAIN-AETEMP'	/Type of calibration data
Extension 6 CALDB keyword setting		
EXTNAME	‘GAIN_NORMAL’	/Name of the binary table extension
CCNM0001	'GAIN_NORMAL'	/Type of calibration data
Extension 7 CALDB keyword setting		
EXTNAME	‘GAIN_PSUM’	/Name of the binary table extension
CCNM0001	'GAIN_PSUM	/Type of calibration data

Table 5.8-old – 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_xiI_quanteff_YYYYMMDD.fits where I=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 six binary table extensions.

5.5.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	EFFICIENCY_CCD	
	Column Names	**Format**	**Units**
	Time	D	s
	Energy	PE(4623)	
	QE_s0_p0	PE(4623)	
	QE_s0_p1	PE(4623)	

Extension N.	*Type*	*Ext. Name*	
	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)	
	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_OBF	
	Column Names	**Format**	**Units**
	Time	D	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)	

Extension N.	*Type*	*Ext. Name*	
	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	
	Column Names	**Format**	**Units**
	Time	D	s
	Energy	PE(2)	keV
4	BINTABLE	EDGE_OBF	
	Column Names	**Format**	**Units**
	Time	D	s
	Energy	PE(4)	keV
5	BINTABLE	EFFICIENCY_CCD_SCI	
	Column Names	**Format**	**Units**
	Time	D	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)	
	QE_s2_p0	PE(4623)	
	QE_s2_p1	PE(4623)	
	QE_s2_p2	PE(4623)	
	QE_s2_p3	PE(4623)	

Extension N.	*Type*	*Ext. Name*	
	QE_s3_p0	PE(4623)	
	QE_s3_p1	PE(4623)	
	QE_s3_p2	PE(4623)	
	QE_s3_p3	PE(4623)	
6	BINTABLE	EDGE_CCD_SCI	
	Column Names	**Format**	**Units**
	Time	D	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		
CALDB and Instrument keywords all extensions		
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
Extension 1 CALDB keyword setting		
EXTNAME	‘EFFICENCY_CCD’	/Name of the binary table extension
CCNM0001	‘EFFICENCY_CCD’	/Type of calibration data
CDES0001	‘Quantum efficency of CCD ’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description

Extension 2 CALDB keyword setting		
EXTNAME	‘EFFICENCY_OBF’	/Name of the binary table extension
CCNM0001	‘EFFICENCY_OBF’	/Type of calibration data
CDES0001	‘Transmission of OBF ’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description
Extension 3 CALDB keyword setting		
EXTNAME	‘EDGE_CCD’	/Name of the binary table extension
CCNM0001	'EDGE_CCD’	/Type of calibration data
CDES0001	‘Atomic edge of CCD ’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description
Extension 4 CALDB keyword setting		
EXTNAME	‘EDGE_OBF’	/Name of the binary table extension
CCNM0001	'EDGE_OBF'	/Type of calibration data
CDES0001	‘Atomic edge of OBF’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description
Extension 5 CALDB keyword setting		
EXTNAME	‘EFFICIENCY_CCD_SCI’	/Name of the binary table extension
CCNM0001	' EFFICIENCY_CCD_SCI''	/Type of calibration data
CDES0001	‘Quantum Efficiency of CCD for SCI data’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description
Extension 6 CALDB keyword setting		
EXTNAME	‘EDGE_CCD_SCI’	/Name of the binary table extension
CCNM0001	'EDGE_CCD_SCI	/Type of calibration data
CDES0001	‘Atomic edge of CCD for SCI data’	/Description
CBD10001	‘FORMAT_VERSION(1)’	/Description

Table 5.10 – Quantum efficiency Calibration Files Extension 1-6 Keyword

where <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_xiI_rmfparam_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 two binary table extensions.

5.6.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	RMF_PARAMETERS	
	Column Names	**Format**	**Units**
	Time	D	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)	
	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)	
	BINTABLE	RMF_PARAMETERS _SCI	

Extension N.	*Type*	*Ext. Name*	
	Column Names	**Format**	**Units**
	Time	D	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)	
	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 1-2 - 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		
CALDB Keywords		

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
CBD10001	‘FORMAT_VERSION(1)’	
1st extension Keywords		
EXTNAME	‘RMF_PARAMETERS’	/Name of the binary table extension
CCNM0001	'RMF_PARAMETERS'	/Type of calibration data
INSTRUME	‘XIS<i>’	/Instrument name
2nd extension Keywords		
EXTNAME	‘RMF_PARAMETERS_SCI’	/Name of the binary table extension
CCNM0001	'RMF_PARAMETERS_SCI’	/Type of calibration data
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 two binary table extension.

5.7.3 File Format

Extension N.	*Type*	*Ext. Name*
0	PRIMARY	

Extension N.	*Type*	*Ext. Name*	
1	BINTABLE	UCODE_LIST	
	Column Names	**Format**	**Units**
	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	16A	
	SNAPTIME	16D	s
	DELAY	16D	s
	COMMENT	64A	
2	BINTABLE	UCODE_LIST_SCI	
	Column Names	**Format**	**Units**
	CODE_ID	I	
	SCI_PERIOD_RAWY	I	
	SCI_START_RAWY	I	
	SCI_ISPEED	I	
	SCI_NROW	I	
	SCI_RAWY	I	
	SCI_AP4_NROW	I	
	SCI_AP4_RAWY	I	
	SCI_AP256_NROW	I	
	SCI_AP256_RAWY	I	
	SCI_HIDDEN_RAWY	I	
	COMMENT	I	

Table 5.13 – Ucodelst 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'UCODE_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
Other File Keywords		
EXTNAME	‘UCODE_LIST’	/Name of the binary table extension
INSTRUME	‘XIS’	/Instrument name

Table 5.14 – Ucodelst Calibration Files Extension 1 Keyword

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

NOTE earlier version of this file has the content of the CCNM001 keyword set to ‘u-code list’.

5.7.6 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		
CALDB Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'UCODE_LIST_SCI'	/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 with SCI’	/Description
Other File Keywords		
EXTNAME	‘UCODE_LIST_SCI’	/Name of the binary table extension
INSTRUME	‘XIS’	/Instrument name

Table 5.15 – Ucodelst Calibration Files Extension 2 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_xiI_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		
	Column Names	**Format**	**Units**
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	
	Column Names	**Format**	**Units**
	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		
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	' XIS Segment C RMF based on ground and in-orbit calibration’	/Description
CBD10001	'ENERG(0.2-16.0)keV'	/Parameter boundary
Response Matrix File Keywords		
EXTNAME	'MATRIX'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	RESPONSE	/Extension contains response data
HDUCLAS2	RSP_MATRIX	/Extension contains RMF
HDUCLAS3	DETECTOR	/convolved w/ detector effects (only)
CHANTYPE	PI	/Channel type
DETCHANS	4096	/Total number of detector channels
INSTRUME	‘XIS<i>’	/Instrument name

Table 5.16 - Response Matrix Calibration File Extension 1 Keywords

where <i> ranges from 0 to 3.

Note earlier version of the response had the following CDB keywords these are now obsolete and the newer response and later version conform with the 5.16 table.

CBD10001	'DETCHANS(4096)'	/Parameter boundary
CBD20001	'CHAN(0-4095)'	/Parameter boundary
CBD30001	'CHANTYPE(“PI”)'	/Parameter boundary

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		
CALDB Keywords		
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	' Energy boundaries of spectral bins'	/Description
CBD10001	'ENERG(0.2-16.0)keV'	/Parameter boundary
Response Matrix File Keywords		
EXTNAME	'EBOUNDS'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	RESPONSE	/Extension contains response data
HDUCLAS2	EBOUNDS	/Extension contains RMF
CHANTYPE	PI	/Channel type
DETCHANS	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.

Note earlier version of the response had the following CDB keywords these are now obsolete and the newer response and later version conform with the 5.16 table.

CBD10001	'DETCHANS(4096)'	/Parameter boundary
CBD20001	'CHAN(0-4095)'	/Parameter boundary
CBD30001	'CHANTYPE("PI")'	/Parameter boundary

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 and the other is when the nominal pointing position is on the HXD. In both cases arfs are generated for different extraction radius (2 ,4 ,6 mm radius which are about 1.4, 2.9 and 4.4. arcmin). The files for the two sets of arfs are named following the convention:

ae_xiI_xisnomX_YYYYMMDD.arf & ae_xiI_hxdnomX_YYYYMMDD.arf

where I=0,3 to identify the 4 XIS units and X to identify the extraction radius.

Note : Earlier version of the arfs used the following naming convention which is now obsolete:

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

There are two formats for the arf. The earlier version listed in table 5.18 was released when the extraction radius was not specified. A second version listed in table 5.18a introduced when the arfs were derived for different extraction radius. The format in 5.18 is now obsolete and future release uses the 5.18a.

Obsolite 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

Valid 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
	RESPERR	E	cm**2
	RESPRERR	E	-
	CONTAMI_TRANSMIS	E	-
	INDEX	I	-

	S	E	-
	T	E	-
	TOTAL	E	count
	DETECT	E	count
	WEISUM	E	count
	RELERR	E	-
	AVGWEI	E	-

Table 5.18a - 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		
CALDB and Others Keywords		
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(0.2-16.0)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

Boundary Keywords for XIS NOMINAL		
CBD20001	'POINTING(XISNOM)'	/Parameter boundary
CBD20001	'RADIUS(x)mm'	/Parameter boundary
CDES0001	'XIS<i> ARF for onaxis position'	/Description
Boundary Keywords for HXD NOMINAL		
CBD20001	'POINTING(HXDNOM)'	/Parameter boundary
CBD30001	'RADIUS(x)mm'	/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 and x has value of 2, 4, 6 .

Note earlier version of the arf did not have the CBD30001 keyword. The CBD10001 had a different value and the CBD20001 for the XIS was set differently. The older setting was the following:

CBD10001	'ENERG(0.2-12.0)keV'	/Parameter boundary
CBD20001	'POINTING(ONAXIS)'	/Parameter boundary

5.10 XIS contamination file

5.10.1 File Name

ae_xiI_contami_YYYYMMDD.fits 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	

	Column Names	Format	Units
1	BINTABLE	CONTAMI_GROWTH	
	TIME	D	s
	DATE	19A	
	A	D	arcmin
	B	D	-
	C	D	10**18 cm**(-2)
2	BINTABLE	EBOUNDS	
	Column Names	**Format**	**Units**
	ENERGY	D	keV
	TRANSMISS	D	-

Table 5.20 – Contamination 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		
CALDB Keywords		
CCLS0001	'BCF'	/Basic Calibration 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 growth’	/Description
CBD10001	'FORMAT_VERSION(1)’	/Parameter boundary
Contamination 1st File Keywords		
EXTNAME	'CONTAMI_GROWTH'	/Extension name

Table 5.21 - Contamination Calibration File Extension 1 Keywords

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		
CALDB Keywords		
CCLS0001	'BCF'	/Basic Calibration 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
Response Matrix File Keywords		
EXTNAME	'CONTAMI_TRANS'	/Extension name

Table 5.22 – Contamination Calibration File Extension 2 Keyword

5.11 XIS light leak file

5.11.1 File Name

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

5.11.2 Description

This file contains the time history of the leak light boundary. This information is used in the task *xisllegtigen* to determine the light leak area. The light leak depends on both position and time however the time dependence has not changed since January 2006. There is one file for each of the detectors. The file format consist of an empty primary table and a binary table extension named ‘ ‘LLE_BOUNDARY’. 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
- DIRECTION: give the LLE boundary direction , ‘H' (horizontal, RAWX direction) or 'V' (vertical, RAWY direction)
- LLE_BOUNDARY : Number of divisions (1-4 for 'H', 1-16 for 'V') in the RAWX or RAWY direction. The default values are 1 in the RAWX direction and 9 in the RAWY direction since 2006-01-20. This means 256 pixel x 113 (or 114) pixel area are used for the light leak estimation.

5.11.3 File Format

Extension N.	*Type*	*Ext. Name*	
0	PRIMARY		
	Column Names	**Format**	**Units**
1	BINTABLE	LLE_BOUNDARY	
	TIME	D	s
	DATE	19A	
	DIRECTION	A	
	LLE_BOUNDARY	B	-

Table 5.23 – Light Leak Calibration File Format

5.11.4 Primary Header Keywords

All keywords of Table 3.1 are mandatory header keywords.

5.11.5 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		
CALDB Keywords		
CCLS0001	'BCF'	/Basic Calibration File
CCNM0001	'LLE_BOUDARY'	/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	' Light Leak estimation boudary’	/Description
CBD10001	'FORMAT_VERSION(1)’	/Parameter boundary
Contamination 1st File Keywords		
EXTNAME	'LLE_BOUNDARY'	/Extension name

Table 5.24 – Light Leak Calibration File Extension 1 Keywords

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	
	Column Names	**Format**	**Units**
	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		

CALDB Keywords		
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		
CALDB Keywords		
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)
Teldef File Keywords		
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	
	Column Names	**Format**	**Units**
	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		
CALDB Keywords		
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_blckfilt_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		
CALDB Keywords		
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
Optical Blocking Filter File Keywords		
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	
	Column Names	**Format**	**Units**
	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		
CALDB Keywords		
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
Filter Transmission File Keywords		
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

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	FTRANS	
	Column Names	**Format**	**Units**
	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		
CALDB Keywords		
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
Gate valve Transmission File Keywords		
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	
	Column Names	**Format**	**Units**
	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		
CALDB Keywords		
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
Quantum Efficiency File Keywords		
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).

PI, 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	19A	-
	DATE_STOP	19A	-
	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		
CALDB Keywords		
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
Gain File Keywords		
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	
	Column Names	**Format**	**Units**
	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		
CALDB Keywords		
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	DETCHANS(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
Response Matrix File Keywords		
EXTNAME	'EBOUNDS'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	'RESPONSE'	/Extension contains response data
HDUCLAS2	'EBOUNDS'	/Extension contains EBOUNDS
CHANTYPE	'PI'	/Channel type
DETCHANS	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		
CALDB Keywords		
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	DETCHANS(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
Response Matrix File Keywords		
EXTNAME	'MATRIX'	/Extension name
HDUCLASS	'OGIP'	/Format conforms to OGIP standards
HDUCLAS1	RESPONSE	/Extension contains response data
HDUCLAS2	RSP_MATRIX	/Extension contains RMF
TLMIN4	0	/First channel in the response
CHANTYPE	PI	/Channel type
DETCHANS	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_xrtI_mirror_YYYYMMDD.fits where I=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

There are two formats for this file. The earlier format listed in table 7.1 and a second listed in table 7.1a. The second format includes the information that used to be stored in the pre-collimator file (see Pre-collimator section). With the second version released for the Mirror file the pre-collimator file became obsolete.

Obsolete 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	8A	-
	breflect	8A	-
	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

Valid format

Extension N.	*Type*	*Ext. Name*	
0	PRIMARY		
1	BINTABLE	MIRROR	
	Column Names	**Format**	**Units**
	layer	J	-
	assembly	J	-
	number	J	-
	fragment	J	-
	function	J	-
	scatter	J	-
	freflect	8A	-
	breflect	8A	-
	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	-
3	BINTABLE	QUADRANT	

	quandrant	I	
	layer	I	
	deltax	D	mm
	deltay	D	mm
	deltaz	D	mm
	deltatx	D	arcmin
	deltaty	D	arcmin
	deltatz	D	arcmin
4	BINTABLE	PCOL	
	layer	J	-
	assembly	J	-
	number	J	-
	fragment	J	-
	function	J	-
	scatter	J	-
	freflect	8A	-
	breflect	8A	-
	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 7.1a– 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		
CALDB and other Keywords		
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
CBD10001	‘GEOMETRY(MIRROR)’	/Parameter boundary
EXTNAME	'MIRROR'	/Name of the binary table extension
XRTS File Keywords		
CDES0001	‘ XRT Mirror Geometry’	/Description
INSTRUME	‘XRT-S’	/Instrument name
XRT<I> Files Keywords		
CDES0001	'XRT Mirror Geometry’	/Description
INSTRUME	‘XRT-I<N>’	/Instrument name

Table 7.2– Mirror geometry File Extension 1 Keywords

where <N> range from 0-3. Previous version of this file had different CDB settings: namely the CDB10001 was reporting and energy range and the CDB20001 had the values currently in the CDB10001. In addition the CDES0001 had a different description.

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		
CALDB and other Keywords		

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
CBD10001	‘GEOMETRY(OBSTRUCT)’	/Parameter boundary
EXTNAME	'OBSTRUCT'	/Name of the binary table extension
XRTS File Keywords		
CDES0001	'XRT Obstruction Geometry’	/Description
INSTRUME	‘XRT-S’	/Instrument name
XRT<I> Files Keywords		
CDES0001	'XRT Obstruction Geometry’	/Description
INSTRUME	‘XRT-I<N>’	/Instrument name

Table 7.3 – Mirror geometry File Extension 2 Keywords

where <N> range from 0-3. Previous version of this file had different CDB settings: namely the CDB10001 was reporting and energy range and the CDB20001 had the values of GEOMETRY(SHADOW). In addition the CDES0001 had a different description and CCNM0001 was set to SHADOW.

7.1.7 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 - Mandatory header keywords		
CALDB and other Keywords		
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
CBD10001	‘GEOMETRY(QUADRANT)’	/Parameter boundary
EXTNAME	'QUADRANT'	/Name of the binary table extension
XRTS File Keywords		

CDES0001	'XRT Quadrant Geometry’	/Description
INSTRUME	‘XRT-S’	/Instrument name
XRT<I> Files Keywords		
CDES0001	'XRT Quadrant Geometry’	/Description
INSTRUME	‘XRT-I<N>’	/Instrument name

Table 7.4 – Mirror geometry File Extension 3 Keywords

where <N> range from 0-3.

7.1.8 Extension 4 - 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 and other Keywords		
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
CBD10001	‘GEOMETRY(PCOL)’	/Parameter boundary
EXTNAME	'PCOL'	/Name of the binary table extension
XRTS File Keywords		
CDES0001	'XRT Pre-collimator Geometry’	/Description
INSTRUME	‘XRT-S’	/Instrument name
XRT<I> Files Keywords		
CDES0001	'XRT Pre-collimator Geometry’	/Description
INSTRUME	‘XRT-I<N>’	/Instrument name

Table 7.5 – Mirror geometry File Extension 4 Keywords

where <N> range from 0-3.

7.2 Pre-Collimator Geometry Calibration File

7.2.1 File Name

ae_xrtI_pcol_YYYYMMDD.fits where I=0,3 to indicate the telescope units

ae_xrts_pcol_YYYYMMDD.fits

NOTE: The first delivery of CALDB includes two files the Pre collimator and the Mirror geometry. In the second CALDB release this file was merged with the Mirror file. Therefore the pre-collimator file is obsolete. The format description is maintained here for record.

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	
	Column Names	**Format**	**Units**
	layer	J	-
	assembly	J	-
	number	J	-
	fragmnet	J	-
	function	J	-
	scatter	J	-
	freflect	8A	-
	breflect	8A	-
	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 7.6 – 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		
CALDB and other Keywords		
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
XRTS File Keywords		
CDES0001	'SUZAKU XRT-S pre-collimator Geometry description’	/Description
INSTRUME	‘XRT-S’	/Instrument name
XRT<I> Files Keywords		
CDES0001	'SUZAKU XRT-I pre-collimator description’	/Description
INSTRUME	‘XRT-<I>’	/Instrument name

Table 7.7 - 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	
	Column Names	**Format**	**Units**
	ENERGY	E	keV
	TRANSMIS	E	-

Table 7.8– 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		
CALDB Keywords		
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 boudary

CDES0001	'XRT Thermal Shield Transmission'	/Description
Precollimator File Keywords		
EXTNAME	'FTRANS'	/Name of the binary table extension

Table 7.9 – 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	
	Column Names	**Format**	**Units**
	ENERGY	D	keV
	REFPROB	4000D	
2	BINTABLE	AEBACK	
	ENERGY	D	keV
	REFPROB	4000D	-
3	BINTABLE	AECOL	
	ENERGY	D	keV
	REFPROB	4000D	-

Table 7.10 – 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		
CALDB Keywords		
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(AEFRONT)’	/Parameter boundaries
CDB20001	‘FORMAT_VERSION(2)‘	/Parameter boundaries
Reflectivity Files Keywords		
EXTNAME	'AEFront’	/Name of the binary table extension
FORMULA	‘Au’	/Surface formula
DENSITY	1.93e1	/Surface cgs density
ROUGH	4.59	/Surface roughness parameter
1CRPX2	1	/Reference pixel in axis1
1CRVL2	0.0	/Angle at reference pixel
1CDLT2	1.74532e-5	/Increment per pixel
1CUNI2	‘rad’	/physical unit of pixel

Table 7.11 – Reflectivity Files Extension 1 Keywords

Note: earlier version of this file have a different value for CBD1001 set to SURFACE(FRONT).

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		
CALDB Keywords		
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(AEBACK)’	/Parameter boundaries
CDB20001	‘FORMAT_VERSION(2)‘	/Parameter boundaries
Reflectivity Files Keywords		
EXTNAME	'AEBACK’	/Name of the binary table extension
FORMULA	‘Al’	/Surface formula
DENSITY	2.69	/Surface cgs density
ROUGH	80	/Surface roughness parameter
1CRPX2	1	/Reference pixel in axis1
1CRVL2	0.0	/Angle at reference pixel
1CDLT2	1.74532e-5	/Increment per pixel
1CUNI2	‘rad’	/physical unit of pixel

Table 7.12 – Reflectivity Files Extension 2 Keywords

Note: earlier version of this file have a different value for CBD1001 set to SURFACE(BACK).

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		
CALDB Keywords		
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 Precollimator surface reflectivity”	/Description
CBD10001	‘SURFACE(AECOL)’	/Parameter boundaries
CDB20001	‘FORMAT_VERSION(2)‘	/Parameter boundaries
Reflectivity Files Keywords		
EXTNAME	'AECol’	/Name of the binary table extension
FORMULA	‘Al’	/Surface formula
DENSITY	2.69	/Surface cgs density
ROUGH	80	/Surface roughness parameter
1CRPX2	1	/Reference pixel in axis1
1CRVL2	0.0	/Angle at reference pixel
1CDLT2	1.74532e-5	/Increment per pixel
1CUNI2	‘rad’	/physical unit of pixel

Table 7.13 – Reflectivity Files Extension 3 Keywords

Note: earlier version of this file have a different value for CBD1001 set to SURFACE(COLLIMATOR).

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	
	Column Names	**Format**	**Units**
	ENERGY	D	keV
	IntensityJ_Kdeg	jD	

Table 7.14 – Backside Calibration Files Format

The file contains 34 columns. The J and K in the 'IntensityJ_Kdeg' columns 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		
CALDB Keywords		
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 foil backside scattering profile'	/Description
CDB10001	'FORMAT_VERSION(2)'	/Parameter boundaries
Reflectivity Files Keywords		
EXTNAME	'BACKPROF'	/Name of the binary table extension
1CRPXn	1	/Reference pixel in axis1
1CRVLn	xx	/Diffangle at reference pixel
1CDLTn	5.0	/Increment per pixel
1CUNIn	'arcmin'	/physical unit of pixel

Table 7.15 – 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_xrtI_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 a binary table.

7.6.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	EFFAREA	
	Column Names	**Format**	**Units**
	OFFAXIS	E	arcmin
	AZIMUTH	nE	deg
	ENERGY	2918D	keV
	EFFAREA	2918D	cm**2
	ENERGY_ID	1B	
	EFFAREA_ID	1B	

Table 7.16– Effective area Calibration File Format

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		
CALDB and other Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File

CCNM0001	'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
CDES0001	‘EFFECTIVE AREA TABLE’	/Brief descriptive summary of this file
CBD10001	‘OFFAXIS(0.0-20.0)arcmin’	/Offaxis-angle
CBD20001	‘AZIMUTH(0-315)deg’	/Azimutal angle
CBD30001	'ENERG(0.1-16.4)keV'	/ X-ray Energy
CBD40001	'FORMAT_VERSION(1)'	/Format version of Suzaku XRT effarea file
EXTNAME	'EFFEAREA'	/Name of the binary table extension
XRT<I> Files Keywords		
INSTRUME	‘XRT-I<i>’	/Instrument name

Table 7.17–Effective area File Extension 1 Keywords

where <i> range from 0-3.

7.7 PSF

7.7.1 File Name

ae_xrtI_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 azimut. The file format consists of an empty primary header, a binary table and image extensions. Note only the binary extension contains CALDB keywords.

7.7.3 File Format

Extension N.	***Type***	***Ext. Name***	
0	PRIMARY		
1	BINTABLE	PSF	
	Column Names	**Format**	**Units**
	ENERGY	E	keV
	OFFAXIS	E	arcmin

	AZIMUTH	E	deg
	XFLIP	I	-
	YFLIP	I	-
	SWAPXY	I	-
	IMAGE_REL_EXT	I	-
2-42	IMAGE	IMAGE_PSF	

Table 7.18–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		
CALDB and other Keywords		
CCLS0001	'BCF'	/Dataset is Basic Calibration File
CCNM0001	'IMAGE_PSF_TABLE'	/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
EXTNAME	'PSF'	/Name of the binary table extension
XRT<I> Files Keywords		
CDES0001	'POINT SPREAD FUNCTION TABLE’	/Description
CBD10001	'OFFAXIS(0.0-20.0)arcmin'	/Off-axis angle
CBD20001	'AZIMUTH(0-315)deg'	/Azimutal angle
CBD30001	'ENERGY(4.51)keV'	/X-ary energy
CBD40001	‘FORMAT_VERSION(1)'	/Format version of Suzaku XRT psf file
INSTRUME	‘XRT-I<i>’	/Instrument name

Table 7.19- PSF File Extension 1 Keywords

where <i> range from 0-3.