MIT Kavli Institute **Chandra X-Ray Center**

MEMORANDUM
March 18, 2014

To: Jonathan McDowell, SDS Group Leader
From: Glenn E. Allen, SDS
Subject: Grade ARD spec
Revision: 1.0
URL: http://space.mit.edu/CXC/docs/docs.html#grade_ard
File: /nfs/inconceivable/d0/SDS/SPECS/ard/grade/grade_ard_1.0.tex

1 Grade ARD

1.1 Description

The grade ARD is used by `acis_process_events` to

- determine the `GRADE` of an event from the `FLTGRADE` for the event and
- obtain the value of the keyword `CORNERS`, which is used during the computation of the summed pulse height `PHA`.

1.2 File structure

A grade ARD file is a FITS file such that:

- HDU 0:
  HDU 0 has a null primary header with no associated image or binary table.
- HDU 1+:
  All HDUs after HDU 0 include headers and binary tables such that
  - Special header keywords:
    - `CBD10001`
    - `CONTENT`
    - `CORNERS`
    - `GRADESYS`
    - `READMODE`

    The keyword `CBD10001` (or `CONTENT` or `READMODE`, for older grade ARD files) is used to determine which HDU (i.e. which `FLTGRADE` to `GRADE` mapping scheme and which value of `CORNERS`) is the appropriate one to use for an event file. The keyword `CORNERS` is used during the computation of the summed pulse height `PHA`.* The keyword `GRADESYS` is propagated to the output event file produced by `acis_process_events`.

*For more information about `CORNERS`, see http://space.mit.edu/CXC/docs/docs.html#grades.

Table 1: The two file structures in use

	File structure	
Quantity	1	2
Effective date	1996-11-01	2009-11-01
HDU 1:		
DATAMODE(s)	CC33_FAINT	CC33_FAINT
	FAINT	FAINT
	FAINT_BIAS	FAINT_BIAS
	RAW	RAW
	VFAINT	VFAINT
CORNERS	2	2
Mapping	1	1
HDU 2:		
DATAMODE(s)	CC33_GRADED	GRADED
	GRADED	
CORNERS	1	1
Mapping	1	1
HDU 3:		
DATAMODE(s)	N/A	CC33_GRADED
CORNERS	N/A	1
Mapping	N/A	**2**

- Table columns:
  * FLTGRADE
  * GRADE

  These columns are described in http://space.mit.edu/CXC/docs/docs.html#grades.

At present, there are two valid grade ARD file structures in the *Chandra* CALDB. These two structures are summarized in Table 1. One structure is used for observations from the beginning of the mission (i.e. an effective date of 1996-11-01) through 2009-10-31. The other structure is used for observations performed from 2009-11-01 to the present.[†] Files that use the first structure contain two HDUs. Files that use the second structure have three. The various observing modes for which each HDU is applicable are listed in the Table, along with the FLTGRADE to GRADE mapping scheme used and the appropriate value of CORNERS. The only difference between the two file structures is for CC33_GRADED mode observations. For the first file structure, such observations use FLTGRADE to GRADE mapping scheme 1 (see Table 2), like all other observing modes. With the second file structure, CC33_GRADED mode observations use mapping scheme 2 (see Table 3), while observations performed using any other mode still use scheme 1. The only difference between these two mapping schemes is that FLTGRADE 66 corresponds to GRADE 7 in scheme 1 and to GRADE 2 in scheme 2.[‡]

[†] A change was made in the onboard software such that for continuous-clocking mode observations taken on and after 2009-11-01 all events were telemetered, except for those that have FLTGRADE = 24, 107, 127, 214, 223, 248, 251, 254, or 255 (i.e. events with FLTGRADE = 66 are telemetered). Most previous continuous-clocking mode observations telemeted only those events that have GRADE = 0–6 (i.e. events with FLTGRADE = 66 were not telemetered).

[‡] For CC33_GRADED mode observations, a significant fraction of real X-ray events can have GRADE = 66 due to the effects of CTI. Since the CTI adjustment used for this mode does not change the GRADEs of the events, it is desirable for such events to have a "good" GRADE (e.g. 2) instead of a bad GRADE (e.g. 7).

Table 2: `FLTGRADE` to `GRADE` mapping scheme 1

`GRADE`	`FLTGRADE`
0	0
1	1, 4, 5, 32, 33, 36, 37, 128, 129, 132, 133, 160, 161, 164, 165
2	2, 34, 64, 65, 68, 69, 130, 162
3	8, 12, 136, 140
4	16, 17, 48, 49
5	3, 6, 9, 13, 20, 21, 35, 38, 40, 44, 52, 53, 96, 97, 100, 101, 131, 134, 137, 141, 144, 145, 163, 166, 168, 172, 176, 177, 192, 193, 196, 197
6	10, 11, 18, 22, 50, 54, 72, 76, 80, 81, 104, 108, 138, 139, 208, 209
7	7, 14, 15, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31, 39, 41, 42, 43, 45, 46, 47, 51, 55, 56, 57, 58, 59, 60, 61, 62, 63, **66**, 67, 70, 71, 73, 74, 75, 77, 78, 79, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 98, 99, 102, 103, 105, 106, 107, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 135, 142, 143, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 167, 169, 170, 171, 173, 174, 175, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 194, 195, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255

Table 3: `FLTGRADE` to `GRADE` mapping scheme 2

`GRADE`	`FLTGRADE`
0	0
1	1, 4, 5, 32, 33, 36, 37, 128, 129, 132, 133, 160, 161, 164, 165
2	2, 34, 64, 65, **66**, 68, 69, 130, 162
3	8, 12, 136, 140
4	16, 17, 48, 49
5	3, 6, 9, 13, 20, 21, 35, 38, 40, 44, 52, 53, 96, 97, 100, 101, 131, 134, 137, 141, 144, 145, 163, 166, 168, 172, 176, 177, 192, 193, 196, 197
6	10, 11, 18, 22, 50, 54, 72, 76, 80, 81, 104, 108, 138, 139, 208, 209
7	7, 14, 15, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31, 39, 41, 42, 43, 45, 46, 47, 51, 55, 56, 57, 58, 59, 60, 61, 62, 63, 67, 70, 71, 73, 74, 75, 77, 78, 79, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 98, 99, 102, 103, 105, 106, 107, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 135, 142, 143, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 167, 169, 170, 171, 173, 174, 175, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 194, 195, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255