Chapter 10

Annotations (AN API)

10.1 Chapter Overview

The HDF annotation interface, the AN interface, supports the storage of labels and descriptions to HDF files and the data objects they contain. This chapter explains the methods used to read and write file and data object annotations using the AN interface.

Note that the AN interface works with multiple files and supersedes the single-file annotations interface, the DFAN interface, described in Chapter 11, Single-file Annotations (DFAN API). Further note that the AN interface can also read files written by DFAN interface routines.

10.2 The Annotation Data Model

When working with different data types, it is often convenient to identify the contents of a file by adding a short text description or ***annotation***. An annotation serves as the explanation for a file or data object, as in "`COLLECTED 12/14/90`" or "`BLACK HOLE SIMULATION`". The annotation can be as short as a name or as long as a portion of source code. For example, if the data originated as satellite data, the annotation might include the source of the data, pertinent environmental conditions, or other relevant information. In the case of a hypothetical black hole simulation, the annotation might contain source code for the program that produced the data.

HDF annotations are designed to accommodate a wide variety of information including titles, comments, variable names, parameters, formulas, and source code. In fact, HDF annotations can encompass any textual information regarding the collection, meaning, or intended use of the data.

Annotations can be attached to files or data objects, and are themselves data objects identifiable by a tag/reference number pair. Refer to Chapter 2, *HDF Fundamentals*, for a description of tag/reference number pairs.

10.2.1 Labels and Descriptions

Annotations come in two forms: ***labels*** and ***descriptions***. ***Labels*** are short annotations used for assigning things like titles or time stamps to a file or its data objects. Longer annotations are called ***descriptions*** and typically contain more extensive information, such as a source code module or mathematical formulae.

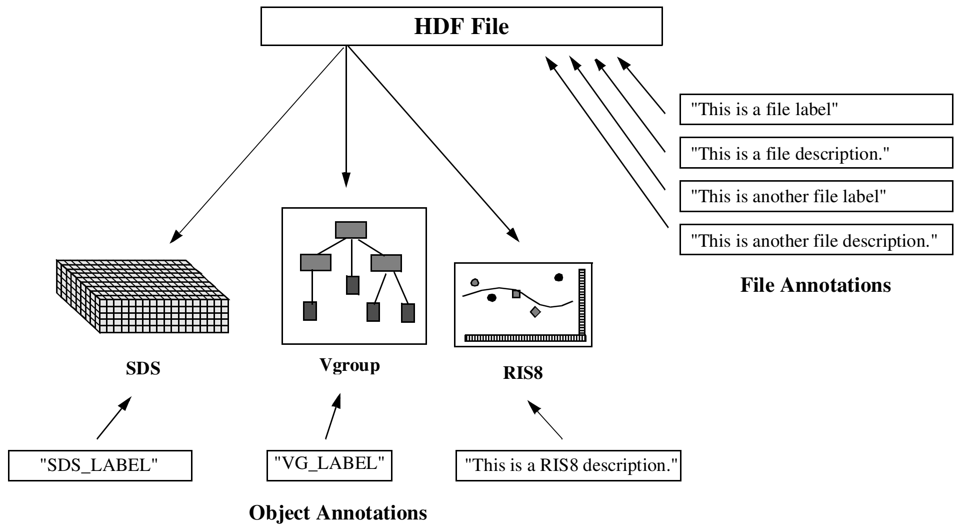
Labels are defined as a null-terminated string of characters. Descriptions may contain any sequence of ASCII characters.

In addition to the distinction made between labels and descriptions, HDF distinguishes between ***file annotations*** and ***object annotations***.

10.2.2 File Annotations

File annotations are assigned to a file to describe the origin, meaning, or intended use of its data. Any HDF file can be annotated with a label, description, or combination of both. (See Figure 10a.) The number of labels or descriptions an HDF file may contain is limited to the maximum number of tag/reference number pairs. File annotations may be assigned in any order and at any time after a file is created.

FIGURE 10a **File and Object Annotations**



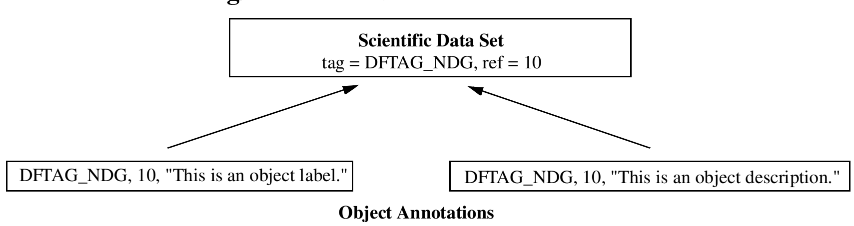
Although it is possible to use a file annotation to describe a data object in a file, this practice is not recommended. Each data object should be described by its own data object annotation as it is added to the file.

10.2.3 Object Annotations

Object annotations are assigned to individual data objects to explain their origin, meaning, or intended use. Because object annotations are assigned to individual objects, their use requires an understanding of HDF tags and reference numbers (see Chapter 2, *HDF Fundamentals*).

The annotation interface takes advantage of this identification scheme by including the object's tag/reference number pair with the text of the annotation. Consider a scientific data set identified by the tag `DFTAG_NDG` and the reference number `10`. (See Figure 10b.) All object annotations assigned to this particular data set must be prefaced with the tag `DFTAG_NDG` followed by the reference number `10`.

FIGURE 10b **Object Annotations with Tag/Reference Number Pairs**



10.2.4 Terminology

The following pairs of terms are used interchangeably in the following discussions: ***data object annotation*** and ***data annotation***; ***data object label*** and ***data label***; ***data object description*** and ***data description***.

10.3 The AN interface

The AN interface permits concurrent operations on a set of annotations that exist in more than one file rather than requiring the program to deal with the annotations on a file-by-file basis.

10.3.1 AN Library Routines

The C routine names of the AN interface are prefaced by the string "AN" and the FORTRAN-77 routine names are prefaced by "af". These routines are divided into the following categories:

- ***Access routines*** initialize and terminate access to the AN interface and the annotation.
- ***Read/write routines*** read and write file or object annotations.
- ***General inquiry routines*** return information about the annotations.

The AN routines are listed in Table 10A and are described in more detail in subsequent sections of this chapter.

TABLE 10A **AN Library Routines**

Category	Routine Names		Description
	C	FORTRAN-77	
Access	`ANstart`	`afstart`	Initializes the AN interface (Section 10.3.4 on page 331)
	`ANcreate`	`afcreate`	Creates a new data annotation (Section 10.3.4 on page 331)
	`ANcreatef`	`affcreate`	Creates a new file annotation (Section 10.3.4 on page 331)
	`ANselect`	`afselect`	Obtains an existing annotation (Section 10.5.1 on page 337)
	`ANendaccess`	`afendaccess`	Terminates access to an annotation (Section 10.3.4 on page 331)
	`ANend`	`afend`	Terminates access to AN interface (Section 10.3.4 on page 331)
Read/write	`ANreadann`	`afreadeann`	Reads an annotation (Section 10.5.2 on page 337)
	`ANwriteann`	`afwriteann`	Writes an annotation (Section 10.4 on page 332)
General Inquiry	`ANannlen`	`afannlen`	Returns the length of an annotation (Section 10.6.2 on page 342)
	`ANannlist`	`afannlist`	Retrieves the annotation identifiers of an object (Section 10.6.4 on page 342)
	`ANatype2tag`	`afatypetag`	Returns the annotation tag corresponding to an annotation type (Section 10.6.8 on page 344)
	`ANfileinfo`	`affileinfo`	Retrieves the number of annotations of each type in a file (Section 10.6.1 on page 341)
	`ANnumann`	`afnumann`	Returns the number of annotations of the given type attached to an object (Section 10.6.3 on page 342)
	`ANget_tagref`	`afgettagref`	Retrieves the tag/reference number pair of an annotation specified by its index (Section 10.6.5 on page 343)
	`ANid2tagref`	`afidtagref`	Retrieves the tag/reference number pair of an annotation specified by its identifier (Section 10.6.6 on page 344)
	`ANtag2atype`	`aftagatype`	Returns the annotation type corresponding to an annotation tag (Section 10.6.9 on page 345)
	`ANtagref2id`	`aftagrefid`	Returns the identifier of an annotation given its tag/reference number pair (Section 10.6.7 on page 344)

10.3.2 Type and Tag Definitions Used in the AN Interface

The AN interface uses the four general annotation types used in HDF: the data label, the data description, the file label and the file description. These annotation types correspondingly map to the `AN_DATA_LABEL` (or `0`), the `AN_DATA_DESC` (or `1`), the `AN_FILE_LABEL` (or `2`) and the `AN_FILE_DESC` (or `3`) definitions. Several routines in the AN interface require one of these type definitions to be passed in as an argument to designate the kind of annotation to be created or accessed.

10.3.3 Programming Model for the AN Interface

As with the GR and SD interfaces, the programming model for the AN interface allows several files to be open concurrently. The contents of these files can be operated on simultaneously as long as the calling program accurately keeps track of each interface. The file and object identifiers returned by the interface. Each object identifier and file identifier must be explicitly disposed of before the termination of the calling program.

The AN interface writes file labels, file descriptions, data object labels, and data object descriptions according to the following programming model:

1. Open the HDF file.
2. Initialize the AN interface.
3. Create a file annotation or a data annotation.
4. Perform the desired operations on the annotation.
5. Terminate access to the annotation.
6. Terminate access to the AN interface.
7. Close the HDF file.

To create a file or object annotation, the calling program must contain the following AN routine calls:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            an_id = ANstart(file_id);

            ann_id = ANcreatef(an_id, annot_type);
    OR      ann_id = ANcreate(an_id, obj_tag, obj_ref, annot_type);

            <Optional operations>

            status = ANendaccess(ann_id);
            status = ANend(an_id);
            status = Hclose(file_id);

FORTRAN:    file_id = hopen(filename, file_access_mode, num_dds_block)
            an_id = afstart(file_id)

            ann_id = affcreate(an_id, annot_type)
    OR      ann_id = afcreate(an_id, obj_tag, obj_ref, annot_type)

            <Optional operations>

            status = afendaccess(ann_id)
            status = afend(an_id)
            status = hclose(file_id)
```

10.3.4 Accessing Files and Annotations: ANstart, ANcreatef, and ANcreate

An HDF file must be opened by **Hopen** before it can be accessed using the AN interface. **Hopen** is described in Chapter 2, *HDF Fundamentals*.

ANstart initializes the AN interface for subsequent AN interface operations. **ANstart** takes one argument, the file identifier, `file_id`, returned by **Hopen**, and returns an AN interface identifier, `an_id` or `FAIL` (or `-1`) upon unsuccessful completion.

ANcreatef creates a file label or file description. It takes two parameters: the AN interface identifier, `an_id`, returned by **ANstart**, and the type of the file annotation to be created, `annot_type`. The parameter `annot_type` must be set to either `AN_FILE_LABEL` (or `2`) or `AN_FILE_DESC` (or `3`). **ANcreatef** returns the file annotation identifier (`ann_id`) if successful, and `FAIL` (or `-1`) otherwise.

ANcreate creates a data label or data description. It takes four parameters: `an_id`, `obj_tag`, `obj_ref`, and `annot_type`. The parameter `an_id` is the AN interface identifier, returned by **ANstart**. The parameters `obj_tag` and `obj_ref` are the tag/reference number pair of the object the annotation will be assigned to. The parameter `annot_type` specifies the type of the data annotation. It must be set to either `AN_DATA_LABEL` (or `0`) or `AN_DATA_DESC` (or `1`). The annotation type definitions are defined in the header file "hdf.h".

ANcreate returns the data annotation identifier (`ann_id`) if successful and `FAIL` (or `-1`) otherwise. The parameters of **ANcreate**, **ANcreatef**, and **ANstart** are further defined in Table 10B.

10.3.5 Terminating Access to Annotations and Files: ANendaccess and ANend

ANendaccess terminates access to the annotation identified by the parameter `ann_id`, which is returned by **ANcreate** or **ANcreatef**. Any subsequent attempts to access this annotation identifier will result in a value of `FAIL` being returned. One **ANendaccess** must be called for every **ANcreate**, **ANcreatef**, or **ANattach**. Each **ANendaccess** returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`).

ANend terminates access to the AN interface identified by the parameter `an_id`, which is returned by **ANstart**. Any subsequent attempts to access the AN interface identifier or to use AN routines will result in a value of `FAIL` being returned.

ANend returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of **ANendaccess** and **ANend** are defined in Table 10B.

The HDF file must be closed by **Hclose** after all calls to **ANend** have been properly made. **Hclose** is described in Chapter 2, *HDF Fundamentals*.

TABLE 10B **ANstart, ANcreate, ANcreatef, ANendaccess and ANend Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
ANstart [int32] **(afstart)**	file_id	int32	integer	File identifier
ANcreate [int32] **(afcreate)**	an_id	int32	integer	AN interface identifier
	obj_tag	uint16	integer	Tag of the object to be annotated
	obj_ref	uint16	integer	Reference number of the object to be annotated
	annot_type	ann_type	integer	Data annotation type
ANcreatef [int32] **(affcreate)**	an_id	int32	integer	AN interface identifier
	annot_type	ann_type	integer	File annotation type

ANendaccess [intn] **(afendaccess)**	ann_id	int32	integer	Annotation identifier
ANend [int32] **(afend)**	an_id	int32	integer	AN interface identifier

10.4 Writing an Annotation: ANwriteann

The AN programming model for writing an annotation is as follows:

1. Create a file annotation or a data annotation.
2. Write to the annotation.
3. Terminate access to the annotation.

To write a file or data annotation, the calling program must contain the following routine calls:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            an_id = ANstart(file_id);

            ann_id = ANcreatef(an_id, annot_type);
      OR    ann_id = ANcreate(an_id, obj_tag, obj_ref, annot_type);

            status = ANwriteann(ann_id, ann_text, ann_length);
            status = ANendaccess(ann_id);
            status = ANend(an_id);
            status = Hclose(file_id);

FORTRAN:    file_id = hopen(filename, file_access_mode, num_dds_block)
            an_id = afstart(file_id)

            ann_id = affcreate(an_id, annot_type)
      OR    ann_id = afcreate(an_id, obj_tag, obj_ref, annot_type)

            status = afwriteann(ann_id, ann_text, ann_length)
            status = afendaccess(ann_id)
            status = afend(an_id)
            status = hclose(file_id)
```

ANwriteann writes the annotation text given in the parameter `ann_text` to the annotation specified by `ann_id`. The parameter `ann_length` specifies the number of characters in the annotation text, not including the `NULL` character. If the annotation has already been written with text, **ANwriteann** will overwrite the current text.

ANwriteann returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of **ANwriteann** are further defined in Table 10C.

TABLE 10C

ANwriteann Parameter List

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
ANwriteann [int32] **(afwriteann)**	ann_id	int32	integer	Annotation identifier
	ann_text	char *	character*(*)	Text of the annotation
	ann_length	int32	integer	Number of characters in the annotation

EXAMPLE 1.

Creating File and Data Annotations

This example illustrates the use of **ANcreatef/affcreate** to create file annotations and **ANcreate/afcreate** to create data annotations.

In this example, the program creates an HDF file named "General_HDFobjects.hdf" then attaches to it two annotations, a file label and a file description. Within the HDF file, the program creates a vgroup named "AN Vgroup" and attaches to it two annotations, a data label and a data description. Refer to Chapter 5, *Vgroups (V API)*, for a discussion of the V interface routines used in this example.

Note that the names `AN_FILE_LABEL`, `AN_FILE_DESC`, `AN_DATA_LABEL`, and `AN_DATA_DESC` are defined by the library to specify the type of the annotation to be accessed.

C:

```
#include "hdf.h"

#define  FILE_NAME      "General_HDFobjects.hdf"
#define  VG_NAME        "AN Vgroup"
#define  FILE_LABEL_TXT "General HDF objects"
#define  FILE_DESC_TXT  "This is an HDF file that contains general HDF objects"
#define  DATA_LABEL_TXT "Common AN Vgroup"
#define  DATA_DESC_TXT  "This is a vgroup that is used to test data annota-
tions"

main( )
{
   /************************* Variable declaration *************************/

   intn   status_n;     /* returned status for functions returning an intn  */
   int32  status_32,    /* returned status for functions returning an int32 */
          file_id,      /* HDF file identifier */
          an_id,        /* AN interface identifier */
          file_label_id,  /* file label identifier */
          file_desc_id,   /* file description identifier */
          data_label_id,  /* data label identifier */
          data_desc_id,   /* data description identifier */
          vgroup_id;
   uint16 vgroup_tag, vgroup_ref;

   /********************* End of variable declaration *********************/

   /*
   * Create the HDF file.
   */
   file_id = Hopen (FILE_NAME, DFACC_CREATE, 0);

   /*
   * Initialize the AN interface.
   */
```

```
an_id = ANstart(file_id);

/*
* Create the file label.
*/
file_label_id = ANcreatef(an_id, AN_FILE_LABEL);

/*
* Write the annotations to the file label.
*/
status_32 = ANwriteann(file_label_id, FILE_LABEL_TXT,
                       strlen (FILE_LABEL_TXT));

/*
* Create file description.
*/
file_desc_id = ANcreatef(an_id, AN_FILE_DESC);

/*
* Write the annotation to the file description.
*/
status_32 = ANwriteann(file_desc_id, FILE_DESC_TXT,
                       strlen (FILE_DESC_TXT));

/*
* Create a vgroup in the V interface.  Note that the vgroup's ref number
* is set to -1 for creating and the access mode is "w" for writing.
*/
status_n = Vstart(file_id);
vgroup_id = Vattach(file_id, -1, "w");
status_32 = Vsetname (vgroup_id, VG_NAME);

/*
* Obtain the tag and ref number of the vgroup for subsequent
* references.
*/
vgroup_tag = (uint16) VQuerytag (vgroup_id);
vgroup_ref = (uint16) VQueryref (vgroup_id);

/*
* Create the data label for the vgroup identified by its tag
* and ref number.
*/
data_label_id = ANcreate(an_id, vgroup_tag, vgroup_ref, AN_DATA_LABEL);

/*
* Write the annotation text to the data label.
*/
status_32 = ANwriteann(data_label_id, DATA_LABEL_TXT,
                       strlen(DATA_LABEL_TXT));

/*
* Create the data description for the vgroup identified by its tag
* and ref number.
*/
data_desc_id = ANcreate(an_id, vgroup_tag, vgroup_ref, AN_DATA_DESC);

/*
* Write the annotation text to the data description.
*/
status_32 = ANwriteann(data_desc_id, DATA_DESC_TXT, strlen(DATA_DESC_TXT));

/*
```

```
   * Teminate access to the vgroup and to the V interface.
   */
   status_32 = Vdetach(vgroup_id);
   status_n = Vend(file_id);

   /*
   * Terminate access to each annotation explicitly.
   */
   status_n = ANendaccess(file_label_id);
   status_n = ANendaccess(file_desc_id);
   status_n = ANendaccess(data_label_id);
   status_n = ANendaccess(data_desc_id);

   /*
   * Terminate access to the AN interface and close the HDF file.
   */
   status_32 = ANend(an_id);
   status_n = Hclose(file_id);
}
```

FORTRAN:

```
      program create_annotation
      implicit none
C
C     Parameter declaration
C
      character*22 FILE_NAME
      character*9  VG_NAME
      character*19 FILE_LABEL_TXT
      character*53 FILE_DESC_TXT
      character*16 DATA_LABEL_TXT
      character*54 DATA_DESC_TXT
C
      parameter (FILE_NAME      = 'General_HDFobjects.hdf',
     +           VG_NAME        = 'AN Vgroup',
     +           FILE_LABEL_TXT = 'General HDF objects',
     +           DATA_LABEL_TXT = 'Common AN Vgroup',
     +           FILE_DESC_TXT  =
     + 'This is an HDF file that contains general HDF objects',
     +           DATA_DESC_TXT  =
     + 'This is a vgroup that is used to test data annotations')
      integer DFACC_CREATE
      parameter (DFACC_CREATE = 4)
      integer AN_FILE_LABEL, AN_FILE_DESC, AN_DATA_LABEL, AN_DATA_DESC
      parameter (AN_FILE_LABEL = 2,
     +           AN_FILE_DESC  = 3,
     +           AN_DATA_LABEL = 0,
     +           AN_DATA_DESC  = 1)
C
C     Function declaration
C
      integer hopen, hclose
      integer afstart, affcreate, afwriteann, afcreate,
     +        afendaccess, afend
      integer vfstart, vfatch, vfsnam, vqref, vqtag, vfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, an_id
      integer file_label_id, file_desc_id
```

```
      integer data_label_id, data_desc_id
      integer vgroup_id, vgroup_tag, vgroup_ref
C
C**** End of variable declaration ************************************
C
C
C     Create the HDF file.
C
      file_id = hopen(FILE_NAME, DFACC_CREATE, 0)
C
C     Initialize the AN interface.
C
      an_id = afstart(file_id)
C
C     Create the file label.
C
      file_label_id = affcreate(an_id, AN_FILE_LABEL)
C
C     Write the annotation to the file label.
C
      status = afwriteann(file_label_id, FILE_LABEL_TXT,
     +                    len(FILE_LABEL_TXT))
C
C     Create file description.
C
      file_desc_id = affcreate(an_id, AN_FILE_DESC)
C
C     Write the annotation to the file description.
C
      status = afwriteann(file_desc_id, FILE_DESC_TXT,
     +                    len(FILE_DESC_TXT))
C
C     Create a vgroup in the file. Note that the vgroup's ref number is
C     set to -1 for creating and the access mode is 'w' for writing.
C
      status    = vfstart(file_id)
      vgroup_id = vfatch(file_id, -1, 'w')
      status    = vfsnam(vgroup_id, VG_NAME)
C
C     Obtain the tag and reference number of the vgroup for subsequent
C     references.
C
      vgroup_ref = vqref(vgroup_id)
      vgroup_tag = vqtag(vgroup_id)
C
C     Create the data label for the vgroup identified by its tag and ref
C     number.
C
      data_label_id = afcreate(an_id, vgroup_tag, vgroup_ref,
     +                         AN_DATA_LABEL)
C
C     Write the annotation text to the data label.
C
      status = afwriteann(data_label_id, DATA_LABEL_TXT,
     +                    len(DATA_LABEL_TXT))

C
C     Create the data description for the vgroup identified by its tag and ref.
C
      data_desc_id = afcreate(an_id, vgroup_tag, vgroup_ref,
     +                        AN_DATA_DESC)
C
C     Write the annotation text to the data description.
```

```
C
      status = afwriteann(data_desc_id, DATA_DESC_TXT,
     +                    len(DATA_DESC_TXT))
C
C     Terminate access to the vgroup and to the V interface.
C
      status = vfdtch(vgroup_id)
      status = vfend(file_id)
C
C     Terminate access to each annotation explicitly.
C
      status = afendaccess(file_label_id)
      status = afendaccess(file_desc_id)
      status = afendaccess(data_label_id)
      status = afendaccess(data_desc_id)
C
C     Terminate access to the AN interface and close the HDF file.
C
      status = afend(an_id)
      status = hclose(file_id)
      end
```

10.5 Reading Annotations Using the AN Interface

Reading an annotation is done by first selecting the desired annotation of the appropriate type using ANselect, then reading the annotation text using ANreadann. These two routines are described in this section.

10.5.1 Selecting an Annotation: ANselect

ANselect obtains the identifier of the annotation specified by its index, `index`, and by its annotation type, `annot_type`. The syntax for **ANselect** is as follows:

```
C:         ann_id = ANselect(an_id, index, annot_type);

FORTRAN:   ann_id = afselect(an_id, index, annot_type)
```

The parameter `index` is a nonnegative integer and is less than the total number of annotations of type `annot_type` in the file. Use **ANfileinfo**, described in Section 10.6.1 on page 341, to obtain the total number of annotations of type `annot_type` in the file.

Possible valid values of `annot_type` are `AN_DATA_LABEL` (or `0`) for a data label, `AN_DATA_DESC` (or `1`) for a data description, `AN_FILE_LABEL` (or `2`) for a file label, and `AN_FILE_DESC` (or `3`) for a file description.

ANselect returns an annotation identifier or `FAIL` (or `-1`) upon unsuccessful completion. The parameters of **ANselect** are further described in Vdata .

10.5.2 Reading an Annotation: ANreadann

ANreadann reads the annotation specified by the parameter `ann_id` and stores the annotation text in the parameter `ann_buf`. The syntax for **ANreadann** is as follows

```
C:         status = ANreadann(ann_id, ann_buf, ann_length);

FORTRAN:   status = afreadann(ann_id, ann_buf, ann_length)
```

The parameter ann_length specifies the size of the buffer ann_buf. If the length of the file or data label to be read is greater than or equal to ann_length, the label will be truncated to ann_length - 1 characters. If the length of the file or data description is greater than ann_length, the description will be truncated to ann_length characters. The HDF library adds a NULL character to the retrieved label but not to the description. The user must add a NULL character to the retrieved description if the C library string functions are to operate on this description.

ANreadann returns either SUCCEED (or 0) or FAIL (or -1). The parameters of **ANreadann** are further described in Table 10D.

TABLE 10D

ANselect and ANreadann Parameter Lists

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
ANselect [int32] **(afselect)**	an_id	int32	integer	AN interface identifier
	index	int32	integer	Index of the annotation
	annot_type	ann_type	integer	Type of the annotation
ANreadann [int32] **(afreadann)**	ann_id	int32	integer	Annotation identifier
	ann_buf	char *	character*(*)	Buffer for the returned annotation text
	ann_length	int32	integer	Number of characters to be retrieved from the annotation

EXAMPLE 2.

Reading File and Data Annotations

This example illustrates the use of **ANfileinfo/affileinfo** to get the number of data and file annotations in the file, **ANselect/afselect** to get an annotation, **ANannlen/afannlen** to get the length of the annotation, and **ANreadann/afreadann** to read the contents of the annotation.

In this example, the program reads some of the annotations created in the file "General_HDFobjects.hdf" by Example 1. The program first gets the information on the annotations in the file so that the number of existing annotations of each kind is available prior to reading. The program then gets the length of each annotation and allocates sufficient space for the contents of the annotation to be read. For the simplicity of this example, only the data labels are read. Any other annotations can be read by adding the for loop with appropriate values as noted below.

This example uses the **ANfileinfo/affileinfo** routine to get annotation information. This rouitne is described in the Section 10.6.1

C:

```
#include "hdf.h"

#define  FILE_NAME   "General_HDFobjects.hdf"

main( )
{
   /************************ Variable declaration *************************/

   intn  status_n;      /* returned status for functions returning an intn  */
   int32 status_32,     /* returned status for functions returning an int32 */
         file_id,       /* HDF file identifier */
         an_id,         /* AN interface identifier */
         ann_id,        /* an annotation identifier */
         index,         /* position of an annotation in all of the same type*/
         ann_length,    /* length of the text in an annotation */
```

```
      n_file_labels, n_file_descs, n_data_labels, n_data_descs;
char *ann_buf;       /* buffer to hold the read annotation */

/********************* End of variable declaration *********************/

/*
* Open the HDF file.
*/
file_id = Hopen (FILE_NAME, DFACC_READ, 0);

/*
* Initialize the AN interface.
*/
an_id = ANstart (file_id);

/*
* Get the annotation information, e.g., the numbers of file labels, file
* descriptions, data labels, and data descriptions.
*/
status_n = ANfileinfo (an_id, &n_file_labels, &n_file_descs,
                     &n_data_labels, &n_data_descs);

/*
* Get the data labels.  Note that this for loop can be used to
* obtain the contents of each kind of annotation with the appropriate
* number of annotations and the type of annotation, i.e., replace
* n_data_labels with n_file_labels, n_file_descs, or n_data_descs, and
* AN_DATA_LABEL with AN_FILE_LABEL, AN_FILE_DESC, or AN_DATA_DESC,
* respectively.
*/
for (index = 0; index < n_data_labels; index++)
{
   /*
   * Get the identifier of the current data label.
   */
   ann_id = ANselect (an_id, index, AN_DATA_LABEL);

   /*
   * Get the length of the data label.
   */
   ann_length = ANannlen (ann_id);

   /*
   * Allocate space for the buffer to hold the data label text.
   */
   ann_buf = malloc ((ann_length+1) * sizeof (char));

   /*
   * Read and display the data label.  Note that the size of the buffer,
   * i.e., the third parameter, is 1 character more than the length of
   * the data label; that is for the null character.  It is not the case
   * when a description is retrieved because the description does not
   * necessarily end with a null character.
   *
   */
   status_32 = ANreadann (ann_id, ann_buf, ann_length+1);
   printf ("Data label index: %d\n", index);
   printf ("Data label contents: %s\n", ann_buf);

   /*
   * Terminate access to the current data label.
   */
   status_n = ANendaccess (ann_id);
```

```
        /*
        * Free the space allocated for the annotation buffer.
        */
        free (ann_buf);
     }

     /*
     * Terminate access to the AN interface and close the HDF file.
     */
     status_32 = ANend (an_id);
     status_n = Hclose (file_id);
}
```

FORTRAN:

```
      program  read_annotation
      implicit none
C
C     Parameter declaration
C
      character*22 FILE_NAME
C
      parameter (FILE_NAME = 'General_HDFobjects.hdf')
      integer    DFACC_READ
      parameter (DFACC_READ = 1)
      integer    AN_DATA_LABEL
      parameter (AN_DATA_LABEL = 0)
C
C     Function declaration
C
      integer hopen, hclose
      integer afstart, affileinfo, afselect, afannlen, afreadann,
     +        afendaccess, afend
C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, an_id, ann_id
      integer index, ann_length
      integer n_file_labels, n_file_descs, n_data_labels, n_data_descs
      character*256 ann_buf
C
C**** End of variable declaration ************************************
C
C
C     Open the HDF file for reading.
C
      file_id = hopen(FILE_NAME, DFACC_READ, 0)
C
C     Initialize the AN interface.
C
      an_id = afstart(file_id)
C
C     Get the annotation information, i.e., the number of file labels,
C     file descriptions, data labels, and data descriptions.
C
      status = affileinfo(an_id, n_file_labels, n_file_descs,
     +                    n_data_labels, n_data_descs)
C
C     Get the data labels. Note that this DO loop can be used to obtain
C     the contents of each kind of annotation with the appropriate number
C     of annotations and the type of annotation, i.e., replace
```

```
C     n_data_labels with n_file_labels, n_files_descs, or n_data_descs, and
C     AN_DATA_LABEL with AN_FILE_LABEL, AN_FILE_DESC, or AN_DATA_DESC,
C     respectively.
C
      do 10 index = 0, n_data_labels-1
C
C     Get the identifier of the current data label.
C
      ann_id = afselect(an_id, index, AN_DATA_LABEL)
C
C     Get the length of the data label.
C
      ann_length = afannlen(ann_id)
C
C     Read and display the data label. The data label is read into buffer
C     ann_buf. One has to make sure that ann_buf has sufficient size to hold
C     the data label. Also note, that the third argument to afreadann is
C     1 greater that the actual length of the data label (see comment to
C     C example).
C
      status = afreadann(ann_id, ann_buf, ann_length+1)
      write(*,*) 'Data label index: ', index
      write(*,*) 'Data label contents: ', ann_buf(1:ann_length)
10    continue
C
C     Terminate access to the current data label.
C
      status = afendaccess(ann_id)
C
C     Terminate access to the AN interface and close the HDF file.
C
      status = afend(an_id)
      status = hclose(file_id)
      end
```

10.6 Obtaining Annotation Information Using the AN Interface

The HDF library provides various AN routines to obtain annotation information for the purpose of locating either a particular annotation or a set of annotations that correspond to a set of search criteria. The following sections describe these AN routines.

10.6.1 Obtaining the Number of Annotations: ANfileinfo

ANfileinfo retrieves the total number of file labels, file descriptions, data labels, and data descriptions in the file identified by the parameter `an_id`. The syntax for **ANfileinfo** is as follows:

```
C:         status = ANfileinfo(an_id, &n_file_labels, &n_file_descs,
                               &n_data_labels, &n_data_descs);

FORTRAN:   status = affileinfo(an_id, n_file_labels, n_file_descs,
                                n_data_labels, n_data_descs)
```

The retrieved information will be stored in the parameters `n_file_labels`, `n_file_descs`, `n_data_labels`, and `n_data_descs`, respectively. They can also be used as loop boundaries.

ANfileinfo returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of **ANfileinfo** are further described in Table 10E.

10.6.2 Getting the Length of an Annotation: ANannlen

ANannlen returns either the length of the annotation, identified by the parameter `ann_id`, or `FAIL` (or `-1`) upon unsuccessful completion. The syntax for **ANannlen** is as follows:

```
C:         ann_len = ANannlen(ann_id);

FORTRAN:   ann_len = afannlen(ann_id)
```

The parameters of **ANannlen** are further described in Table 10E.

TABLE 10E **ANfileinfo and ANannlen Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
ANfileinfo [intn] **(affileinfo)**	an_id	int32	integer	AN interface identifier
	n_file_labels	int32 *	integer	Number of file labels in the file
	n_file_descs	int32 *	integer	Number of file descriptions in the file
	n_data_labels	int32 *	integer	Number of data labels in the file
	n_data_descs	int32 *	integer	Number of data descriptions in the file
ANannlen [int32] **(afannlen)**	ann_id	int32	integer	Annotation identifier

10.6.3 Obtaining the Number of Specifically-typed Annotations of a Data Object: ANnumann

ANnumann returns the total number of annotations that are of type `annot_type` and that are attached to the object identified by its tag, `obj_tag`, and reference number, `obj_ref`. The syntax for **ANnumann** is as follows:

```
C:         ann_num = ANnumann(an_id, annot_type, obj_tag, obj_ref);

FORTRAN:   ann_num = afnumann(an_id, annot_type, obj_tag, obj_ref)
```

As this routine is implemented only to obtain the total number of data annotations and not file annotations, the valid values of `annot_type` are `AN_DATA_LABEL` (or `0`) and `AN_DATA_DESC` (or `1`). To obtain the total number of file annotations or all data annotations, use **ANfileinfo**.

ANnumann returns the total number of qualified annotations or `FAIL` (or `-1`). The parameters of **ANnumann** are further described in Table 10F.

10.6.4 Obtaining the List of Specifically-typed Annotation Identifiers of a Data Object: ANannlist

ANannlist retrieves the annotation identifiers for all of the annotations that are of type `annot_type` and belong to the object identified by its tag, `obj_tag`, and its reference number, `obj_ref`. The syntax for **ANannlist** is as follows:

```
C:         status = ANannlist(an_id, annot_type, obj_tag, obj_ref,
                       ann_list);

FORTRAN:   status = afselect(an_id, annot_type, obj_tag, obj_ref,
                       ann_list)
```

The identifiers of the retrieved annotations are stored in the parameter ann_list. The routine **ANnumann** can be used to obtain the number of annotations to be retrieved for dynamic memory allocation.

ANannlist returns either SUCCEED (or 0) or FAIL (or -1). The parameters of **ANannlist** are further described in Table 10F.

TABLE 10F **ANnumann and ANannlist Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
ANnumann [intn] **(afnumann)**	an_id	int32	integer	AN interface identifier
	annot_type	ann_type	integer	Type of the annotation
	obj_tag	uint16	integer	Tag of the object the annotation is attached to
	obj_ref	uint16	integer	Reference number of the object the annotation is attached to
ANannlist [intn] **(afannlist)**	an_id	int32	integer	AN interface identifier
	annot_type	ann_type	integer	Type of the annotation
	obj_tag	uint16	integer	Tag of the object the annotation is attached to
	obj_ref	uint16	integer	Reference number of the object the annotation is attached to
	ann_list	int32 *	integer (*)	Buffer for returned annotation identifiers that match the search criteria

10.6.5 Obtaining the Tag/Reference Number Pair of the Specified Annotation Index and Type: ANget_tagref

ANget_tagref retrieves the tag and reference number of the annotation identified by its index, specified by the parameter index, and by the annotation type, specified by the parameter annot_type. The syntax for **ANget_tagref** is as follows:

```
C:          status = ANget_tagref(an_id, index, annot_type, &ann_tag,
                           &ann_ref);

FORTRAN:    status = afgettagref(an_id, index, annot_type, ann_tag,
                           ann_ref)
```

The tag is stored in the parameter ann_tag and the reference number is stored in the parameter ann_ref. The parameter index is a nonnegative value and is less than the total number of annotations of type annot_type in the file. Use **ANfileinfo** to obtain the total number of annotations of type annot_type in the file.

The value of annot_type can be either AN_DATA_LABEL (or 0), AN_DATA_DESC (or 1), AN_FILE_LABEL (or 2), or AN_FILE_DESC (or 3).

ANget_tagref returns either SUCCEED (or 0) or FAIL (or -1). The parameters of **ANget_tagref** are further described in Table 10G on page 345.

10.6.6 Obtaining the Tag/Reference Number Pair from a Specified Annotation Identifier: ANid2tagref

ANid2tagref retrieves the tag/reference number pair of the annotation identified by the parameter `ann_id`. The syntax for **ANid2tagref** is as follows:

```
C:        status = ANid2tagref(ann_id, &ann_tag, &ann_ref);

FORTRAN:  status = afidtagref(ann_id, ann_tag, ann_ref)
```

ANid2tagref stores the retrieved tag and reference number into the parameters `ann_tag` and `ann_ref`. Possible values returned in `ann_tag` are `DFTAG_DIL` (or `104`) for a data label, `DFTAG_DIA` (or `105`) for a data description, `DFTAG_FID` (or `100`) for a file label, and `DFTAG_FD` (or `101`) for a file description.

ANid2tagref returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of **ANid2tagref** are further described in Table 10G on page 345.

10.6.7 Obtaining the Annotation Identifier from a Specified Tag/Reference Number Pair: ANtagref2id

ANtagref2id routine returns the identifier of the annotation that is specified by its tag/reference number pair or `FAIL` (or `-1`). The syntax for **ANtagref2id** is as follows:

```
C:        ann_id = ANtagref2id(an_id, ann_tag, ann_ref);

FORTRAN:  ann_id = aftagrefid(an_id, ann_tag, ann_ref)
```

The parameters of **ANtagref2id** are further described in Table 10G on page 345.

10.6.8 Obtaining an Annotation Tag from a Specified Annotation Type: ANatype2tag

ANatype2tag returns the tag that corresponds to the annotation type specified by the parameter `annot_type` if successful, or `DFTAG_NULL` (or `0`) otherwise. The syntax for **ANatype2tag** is as follows:

```
C:        ann_tag = ANatype2tag(annot_type);

FORTRAN:  ann_tag = afatypetag(annot_type)
```

The following table lists the valid values of `annot_type` in the left column and the corresponding values for the returned annotation tag on the right.

Annotation Type	Annotation Tag
AN_DATA_LABEL (or 0)	DFTAG_DIL (or 104)
AN_DATA_DESC (or 1)	DFTAG_DIA (or 105)
AN_FILE_LABEL (or 2)	DFTAG_FID (or 100)
AN_FILE_DESC (or 3)	DFTAG_FD (or 101)

The parameters of **ANatype2tag** are further described in Table 10G.

10.6.9 Obtaining an Annotation Type from a Specified Object Tag: ANtag2atype

ANtag2atype returns the annotation type corresponding to the annotation tag `ann_tag` if successful, or `AN_UNDEF` (or `-1`) otherwise. The syntax for **ANtag2atype** is as follows:

```
C:          annot_type = ANtag2atype(ann_tag);

FORTRAN:    annot_type = aftagatype(ann_tag)
```

The following table lists the valid values of `ann_tag` in the left column and the corresponding values of the returned annotation type in the right column.

Annotation Tag	Annotation Type
`DFTAG_DIL` (or `104`)	`AN_DATA_LABEL` (or `0`)
`DFTAG_DIA` (or `105`)	`AN_DATA_DESC` (or `1`)
`DFTAG_FID` (or `100`)	`AN_FILE_LABEL` (or `2`)
`DFTAG_FD` (or `101`)	`AN_FILE_DESC` (or `3`)

The parameters of **ANtag2atype** are further described in Table 10G.

TABLE 10G **ANget_tagref, ANid2tagref, ANtagref2id, ANatype2tag, and ANtag2atype Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
ANget_tagref [int32] **(afgettagref)**	an_id	int32	integer	AN interface identifier
	ann_index	int32	integer	Index of the annotation
	annot_type	ann_type	integer	Annotation type of the annotation
	ann_tag	uint16 *	integer	Tag of the annotation
	ann_ref	uint16 *	integer	Reference number of the annotation
ANid2tagref [int32] **(afidtagref)**	ann_id	int32	integer	Identifier of the annotation
	ann_tag	uint16 *	integer	Tag of the annotation
	ann_ref	uint16 *	integer	Reference number of the annotation
ANtagref2id [int32] **(aftagrefid)**	an_id	int32	integer	AN interface identifier
	ann_tag	uint16	integer	Tag of the annotation
	ann_ref	uint16	integer	Reference number of the annotation
ANatype2tag [uint16] **(afatypetag)**	annot_type	ann_type	integer	Annotation type
ANtag2atype [ann_type] **(aftagatype)**	ann_tag	uint16	integer	Annotation tag

EXAMPLE 3.

Obtaining Annotation Information

This example illustrates the use of **ANnumann/afnumann** to obtain the number of annotations of an object, **ANannlist/afannlist** to obtain the list of annotation identifiers, and **ANid2tagref/afidtagref**, **ANatype2tag/afatypetag**, and **ANtag2atype/aftagatype** to perform some identifier conversions.

In this example, the program locates the vgroup named "AN Vgroup" that was created in the file "General_HDFobjects.hdf" by Example 1. The program then gets the number of data descriptions that this vgroup has and the list of their identifiers. If there are any identifers in the list, the program displays the corresponding reference numbers. Finally, the program makes two simple conversions, from an annotation type to a tag and from a tag to an annotation type, and displays the results.

C:

```
#include "hdf.h"

#define  FILE_NAME   "General_HDFobjects.hdf"
#define  VG_NAME     "AN Vgroup"

main( )
{
   /************************* Variable declaration *************************/

   intn   status_n;      /* returned status for functions returning an intn */
   int32  status_32,     /* returned status for functions returning an int32*/
          file_id, an_id, ann_id,
          n_annots,      /* number of annotations */
         *ann_list,      /* list of annotation identifiers */
          vgroup_ref,    /* reference number of the vgroup */
          index;         /* index of an annotation in the annotation list */
          ann_type annot_type = AN_DATA_DESC;   /* annotation to be obtained*/
   uint16 ann_tag, ann_ref,              /* tag/ref number of an annotation */
          vgroup_tag = DFTAG_VG;         /* tag of the vgroup */

   /********************* End of variable declaration *********************/

   /*
   * Create the HDF file.
   */
   file_id = Hopen (FILE_NAME, DFACC_READ, 0);

   /*
   * Initialize the V interface.
   */
   status_n = Vstart (file_id);

   /*
   * Get the vgroup named VG_NAME.
   */
   vgroup_ref = Vfind  (file_id, VG_NAME);

   /*
   * Initialize the AN interface and obtain an interface id.
   */
   an_id = ANstart (file_id);

   /*
   * Get the number of object descriptions.  Note that, since ANnumann takes
   * the tag and reference number as being of type unit16, vgroup_ref must be
   * safely cast to uint16 by checking for FAIL value first.
```

```
   */
   if (vgroup_ref != FAIL)
   {
      n_annots = ANnumann (an_id, annot_type, vgroup_tag, (uint16)vgroup_ref);

      /*
      * Allocate space to hold the annotation identifiers.
      */
      ann_list = malloc (n_annots * sizeof (int32));

      /*
      * Get the list of identifiers of the annotations attached to the
      * vgroup and of type annot_type.
      */
      n_annots = ANannlist (an_id, annot_type, vgroup_tag, (uint16)vgroup_ref,
                            ann_list);

      /*
      * Get each annotation identifier from the list then display the
      * tag/ref number pair of the corresponding annotation.
      */
      printf ("List of annotations of type AN_DATA_DESC:\n");
      for (index = 0; index < n_annots; index++)
      {
        /*
         * Get and display the ref number of the annotation from
         * its identifier.
         */
         status_32 = ANid2tagref (ann_list[index], &ann_tag, &ann_ref);
         printf ("Annotation index %d: tag = %s\nreference number= %d\n",
           index, ann_tag == DFTAG_DIA ? "DFTAG_DIA (data description)":
           "Incorrect", ann_ref);
      } /* for */
   } /* for */

   /*
   * Get and display an annotation type from an annotation tag.
   */
   annot_type = ANtag2atype (DFTAG_FID);
   printf ("\nAnnotation type of DFTAG_FID (file label) is %s\n",
              annot_type == AN_FILE_LABEL ? "AN_FILE_LABEL":"Incorrect");

   /*
   * Get and display an annotation tag from an annotation type.
   */
   ann_tag = ANatype2tag (AN_DATA_LABEL);
   printf ("\nAnnotation tag of AN_DATA_LABEL is %s\n",
              ann_tag == DFTAG_DIL ? "DFTAG_DIL (data label)":"Incorrect");

   /*
   * Terminate access to the AN interface and close the HDF file.
   */
   status_32 = ANend (an_id);
   status_n = Hclose (file_id);

   /*
   * Free the space allocated for the annotation identifier list.
   */
   free (ann_list);
}
```

FORTRAN:

```
      program annotation_info
      implicit none
C
C     Parameter declaration
C
      character*22 FILE_NAME
      character*9  VG_NAME
C
      parameter (FILE_NAME      = 'General_HDFobjects.hdf',
     +           VG_NAME        = 'AN Vgroup')
      integer    DFACC_READ
      parameter (DFACC_READ = 1)
      integer AN_FILE_LABEL, AN_DATA_LABEL, AN_DATA_DESC
      parameter (AN_FILE_LABEL = 2,
     +           AN_DATA_LABEL = 0,
     +           AN_DATA_DESC  = 1)
      integer DFTAG_DIA, DFTAG_FID, DFTAG_DIL
      parameter (DFTAG_DIA = 105,
     +           DFTAG_FID = 100,
     +           DFTAG_DIL = 104)
      integer DFTAG_VG
      parameter (DFTAG_VG = 1965)
C
C     Function declaration
C
      integer hopen, hclose
      integer afstart, afnumann, afannlist, afidtagref, aftagatype,
     +        afatypetag, afend
      integer vfstart, vfind

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, an_id
      integer n_annots, ann_index, annot_type, ann_tag, ann_ref
      integer ann_list(10)
      integer vgroup_tag, vgroup_ref
C
C**** End of variable declaration ************************************
C
      annot_type = AN_DATA_DESC
      vgroup_tag = DFTAG_VG
C
C     Open the HDF file for reading.
C
      file_id = hopen(FILE_NAME, DFACC_READ, 0)
C
C     Initialize the V interface.
C
      status = vfstart(file_id)
C
C     Get the group named VG_NAME.
C
      vgroup_ref = vfind(file_id, VG_NAME)
C
C     Initialize the AN interface.
C
      an_id = afstart(file_id)

C
```

```
C     Get the number of object descriptions.
C
      if (vgroup_ref .eq. -1) goto 100
      n_annots = afnumann(an_id, annot_type, vgroup_tag, vgroup_ref)
C
C     Get the list of identifiers of the annotations attached to the
C     vgroup and of type annot_type. Identifiers are read into ann_list
C     buffer. One has to make sure that ann_list has the size big enough
C     to hold the list of identifiers.
C
      n_annots = afannlist(an_id, annot_type, vgroup_tag, vgroup_ref,
     +                     ann_list)
C
C     Get each annotation identifier from the list then display the
C     tag/ref number pair of the corresponding annotation.
C
      write(*,*) 'List of annotations of type AN_DATA_DESC'
      do 10 ann_index = 0, n_annots - 1
C
C     Get and display the ref number of the annotation from its
C     identifier.
C
      status = afidtagref(ann_list(ann_index+1), ann_tag, ann_ref)
      write(*,*) 'Annotation index: ', ann_index
      if (ann_tag .eq. DFTAG_DIA) then
          write(*,*) 'tag = DFTAG_DIA (data description)'
      else
          write(*,*) ' tag = Incorrect'
      endif
      write(*,*) 'reference number = ', ann_ref
10    continue
C
C     Get and display an annotation type from an annotation tag.
C
      annot_type = aftagatype(DFTAG_FID)
      if (annot_type .eq. AN_FILE_LABEL) then
         write(*,*) 'Annotation type of DFTAG_FID (file label) is ',
     +              'AN_FILE_LABEL '
      else
         write(*,*) 'Annotation type of DFTAG_FID (file label) is ',
     +              'Incorrect'
      endif
C
C     Get and display an annotation tag from an annotation type.
C
      ann_tag = afatypetag(AN_DATA_LABEL)
      if (ann_tag .eq. DFTAG_DIL ) then
         write(*,*) 'Annotation tag of AN_DATA_LABEL is ',
     +              'DFTAG_DIL (data label)'
      else
         write(*,*) 'Annotation type of DFTAG_FID (file label) is ',
     +              'Incorrect'
      endif
C
C     Terminate access to the AN interface and close the HDF file.
C
100   continue
      status = afend(an_id)
      status = hclose(file_id)
      end
```