Chapter 5

Vgroups (V API)

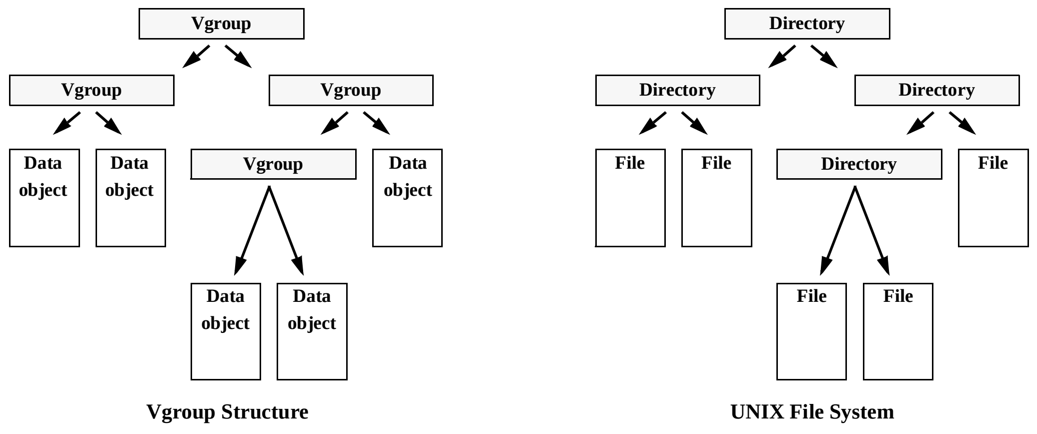
5.1 Chapter Overview

This chapter describes the vgroup data model and the Vgroup interface (also called the V interface or the V API). The first section describes the vgroup data model. The second section introduces the Vgroup interface, followed by a presentation of a programming model for vgroups. The next three sections describe the use of the Vgroup interface in accessing and creating vgroups. The final two sections cover vgroup attributes and obsolete Vgroup interface routines.

5.2 The Vgroup Data Model

A ***vgroup*** is a structure designed to associate related data objects. The general structure of a vgroup is similar to that of the UNIX file system in that the vgroup may contain references to other vgroups or HDF data objects just as the UNIX directory may contain subdirectories or files (see Figure 5a). In previous versions of HDF, the data objects in a vgroup were limited to vdatas and vgroups. The data objects that belong to a vgroup are often referred to as the vgroup's ***members***.

FIGURE 5a **Similarity of the HDF Vgroup Structure and the UNIX File System**



5.2.1 Vgroup Names and Classes

A vgroup has a required ***vgroup name*** and an optional ***vgroup class*** associated with it. The vgroup name and class are used in describing and classifying the data objects belonging to the vgroup.

A vgroup name is a character string and is used to semantically distinguish between vgroups in an HDF file. If the user does not assign a name to a vgroup, then the HDF library will assign a zero-length string as the name of the vgroup. Multiple vgroups in a file can have the same name; however, unique names make it easier to distinguish among vgroups and are recommended.

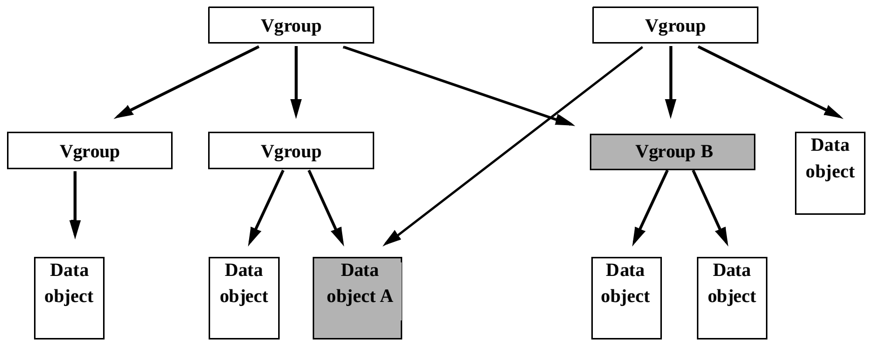
A vgroup class is a character string and can be used to classify data objects by their intended use. For example, a vdata object named "Storm Tracking Data - 5/11/94" and another vdata object named "Storm Tracking Data - 6/23/94" can be grouped together under a vgroup named "Storm Tracking Data - 1994". If the data was collected in Anchorage, Alaska the class name might be "Anchorage Data", particularly if other vgroups contain storm track data collected in different locations. A class name is not required for a vgroup, therefore the HDF library will not assign a class name to the vgroup if one is not defined by the user.

The specific use of the vgroup name and class name is solely determined by HDF users.

5.2.2 Vgroup Organization

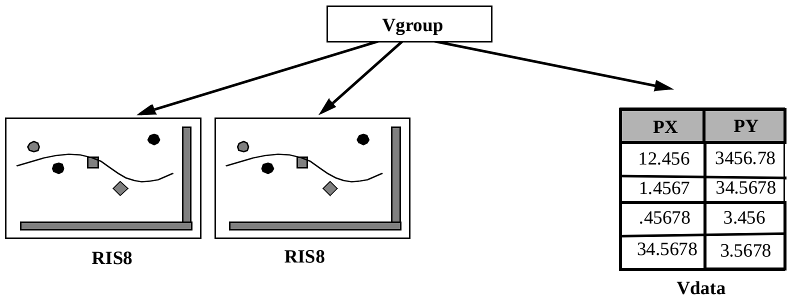
There are many ways to organize vgroups through the use of the Vgroup interface. Vgroups may contain any number of vgroups and data objects, including data objects and vgroups that are members of other vgroups. Therefore, a data object may have more than one parent vgroup. For example, Data object A and Vgroup B, shown in Figure 5b, are members of multiple vgroups with different organizational structures.

FIGURE 5b **Sharing Data Objects among Vgroups**



A vgroup can contain any combination of data objects. Figure 5c illustrates a vgroup that contains two raster images and a vdata.

FIGURE 5c **A Vgroup Containing Two 8-Bit Raster Images, or RIS8 Objects, and a Vdata**



PX	PY
12.456	3456.78
1.4567	34.5678
.45678	3.456
34.5678	3.5678

5.2.3 An Example Using Vgroups

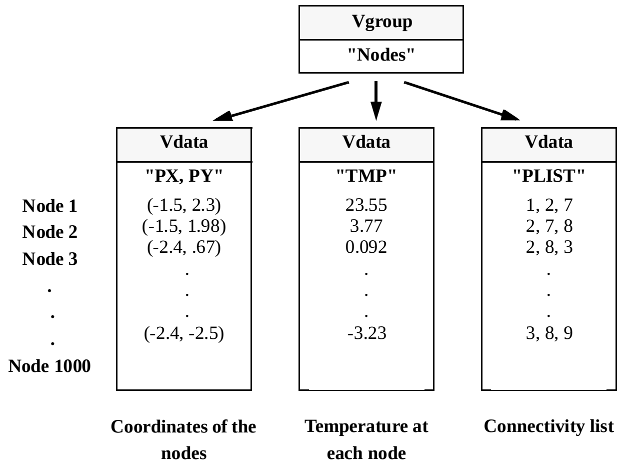
Although vgroups can contain any combination of HDF data objects, it is often useful to establish conventions on the content and structure of vgroups. This section, with the illustration in Figure 5d, describes an example of a vgroup convention that is used by scientific and graphics programmers to describe the surfaces of a mathematical or material object as well as its properties.

This vgroup consists of one list of coordinate data, one list of connectivity data, and one list of node property data. These three lists are stored in separate vdata objects within the vgroup.

Each 2-dimensional coordinate in the list of coordinate data defines the relative location of a vertex, or ***node***. Each entry in the list of connectivity data is an ordered list of node numbers which describes a polygon. This ordered list is referred to as the ***connectivity list***. For example, the number "2" as an item in a connectivity list would represent the second entry in the node table. ***Node properties*** are user-defined values attached to each node within the polygon and can be numbers or characters.

For example, consider a heated mesh of 400 triangles formed by connecting 1000 nodes. A vgroup describing this mesh might contain the coordinates of the vertices, the temperature value of the vertices, and a connectivity list describing the edges of the triangles.

FIGURE 5d **Vgroup Structure Describing a Heated Mesh**



5.3 The Vgroup Interface

The Vgroup interface consists of routines for creating and accessing vgroups, and getting information about vgroups and their members.

5.3.1 Vgroup Interface Routines

Vgroup interface routine names are prefaced by "V" in C and by "vf" in FORTRAN-77. These routines are categorized as follows:

- ***Access/Create routines*** control access to the Vgroup interface and to individual vgroups.
- ***Manipulation routines*** modify vgroups' characteristics, and add and delete vgroups' members.
- ***Vgroup inquiry routines*** obtain information about vgroups. Some of these routines are useful for locating vgroups in a file.
- ***Member inquiry routines*** obtain information about members of vgroups.
- ***Attributes routines*** provide information about vgroups' attributes.

The Vgroup interface routines are listed in Table 5A below and described in the following sections.

TABLE 5A **Vgroup Interface Routines**

Category	Routine Name		Description
	C	FORTRAN-77	
Access/Create	`Vstart`	`vfstart`	Initializes the Vdata and Vgroup interfaces (Section 5.4.1 on page 192)
	`Vattach`	`vfatch`	Establishes access to a vgroup (Section 5.4.1 on page 192)
	`Vdetach`	`vfdtch`	Terminates access to a vgroup (Section 5.4.2 on page 193)
	`Vend`	`vfend`	Terminates access to the Vdata and Vgroup interfaces (Section 5.4.2 on page 193)
Manipulation	`Vaddtagref`	`vfadtr`	Adds an HDF data object to a vgroup (Section 5.5.2 on page 195)
	`Vdelete`	`vdelete`	Removes a vgroup from a file (Section 5.7.1 on page 221)
	`Vdeleteta-gref`	`vfdtr`	Detaches a member from a vgroup (Section 5.7.2 on page 221)
	`Vinsert`	`vfinsrt`	Adds a vgroup or vdata to an existing vgroup (Section 5.5.3 on page 195)
	`Vsetclass`	`vfscls`	Assigns a class name to a vgroup (Section 5.5.1 on page 195)
	`Vsetname`	`vfsnam`	Assigns a name to a vgroup (Section 5.5.1 on page 195)

Vgroup Inquiry	`Vfind`	`vfind`	Returns the reference number of a vgroup given its name (Section 5.6.1.5 on page 209)
	`Vfindclass`	`vfndcls`	Returns the reference number of a vgroup specified by class name (Section 5.6.1.6 on page 210)
	`Vgetclass`	`vfgcls`	Retrieves the class of a vgroup (Section 5.6.1.4 on page 209)
	`Vgetid`	`vfgid`	Returns the reference number for the next vgroup in the HDF file (Section 5.6.1.2 on page 208)
	`Vgetname`	`vfgnam`	Retrieves the name of a vgroup (Section 5.6.1.3 on page 209)
	`Vgetversion`	`vfgver`	Returns the vgroup version of a vgroup (Section 5.8.1 on page 222)
	`Vinquire`	`vfinq`	Retrieves general information about a vgroup (Section 5.9.2 on page 229)
	`Vlone`	`vflone`	Retrieves the reference numbers of vgroups that are not members of other vgroups (Section 5.6.1.1 on page 208)
	`Vntagrefs`	`vfntr`	Returns the number of tag/reference number pairs contained in the specified vgroup (Section 5.6.2.1 on page 213)
	`VQueryref`	`vqref`	Returns the reference number of a vgroup (Section 5.6.2.9 on page 216)
	`VQuerytag`	`vqtag`	Returns the tag of a vgroup (Section 5.6.2.10 on page 217)
Member Inquiry	`Vflocate`	`vffloc`	Locates a vdata in a vgroup given a list of field names (Section 5.6.2.7 on page 216)
	`Vgetnext`	`vfgnxt`	Returns the identifier of the next vgroup or vdata in a vgroup (Obsolete) (Section 5.9.1 on page 228)
	`Vgettagref`	`vfgttr`	Retrieves a tag/reference number pair for a data object in the vgroup (Section 5.6.2.2 on page 214)
	`Vgettagrefs`	`vfgttrs`	Retrieves the tag/reference number pairs of all of the data objects belonging to a vgroup (Section 5.6.2.3 on page 214)
	`Vinqtagref`	`vfinqtr`	Determines whether a data object belongs to a vgroup (Section 5.6.2.4 on page 215)
	`Visvg`	`vfisvg`	Determines whether a data object is a vgroup within another vgroup (Section 5.6.2.5 on page 215)
	`Visvs`	`vfisvs`	Determines whether a data object is a vdata within a vgroup (Section 5.6.2.6 on page 215)
	`Vnrefs`	`vnrefs`	Retrieves the number of tags of a given tag type in a vgroup (Section 5.6.2.8 on page 216)
Attributes	`Vattrinfo`	`vfainfo`	Retrieves information of a vgroup attribute (Section 5.8.2 on page 222)
	`Vfindattr`	`vffdatt`	Returns the index of a vgroup attribute given the attribute name (Section 5.8.6 on page 224)
	`Vgetattr`	`vfgnatt/` `vfgcatt`	Retrieves the values of a vgroup attribute (Section 5.8.5 on page 224)
	`Vnattrs`	`vfnatts`	Returns the total number of vgroup attributes (Section 5.8.3 on page 223)
	`Vsetattr`	`vfsnatt/` `vfscatt`	Sets the attribute of a vgroup (Section 5.8.4 on page 223)

5.3.2 Identifying Vgroups in the Vgroup Interface

The Vgroup interface identifies vgroups in several ways. In some cases, a vgroup can be accessed directly through the use of its unique ***reference number***. In other cases, the reference number and the routine **Vattach** are used to obtain a vgroup identifier. The reference number of a vgroup can be obtained from the name or the class of the vgroup, or by sequentially traversing the file. The concept of reference number is discussed in Section 2.2.2.1 on page 8.

When a vgroup is attached or created, it is assigned an identifier, called ***vgroup id***. After a vgroup has been attached or created, its identifier is used by the Vgroup interface routines in accessing the vgroup.

5.4 Programming Model for the Vgroup Interface

The programming model for accessing vgroups is as follows:

1. Open an HDF file.
2. Initialize the Vgroup interface.
3. Create a new vgroup or open an existing one.
4. Perform the desired operations on the vgroup.
5. Terminate access to the vgroup.
6. Terminate access to the Vgroup interface.
7. Close the file.

These steps correspond to the following sequence of function calls:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            status = Vstart(file_id);
            vgroup_id = Vattach(file_id, vgroup_ref, vg_access_mode);
            <Optional operations>
            status = Vdetach(vgroup_id);
            status = Vend(file_id);
            status = Hclose(file_id);

FORTRAN:    file_id = hopen(filename, file_access_mode, num_dds_block)
            status = vfstart(file_id)
            vgroup_id = vfatch(file_id, vgroup_ref, vg_access_mode)
            <Optional operations>
            status = vfdtch(vgroup_id)
            status = vfend(file_id)
            status = hclose(file_id)
```

The calling program must obtain a separate vgroup identifier for each vgroup to be accessed.

5.4.1 Accessing Files and Vgroups: Vstart and Vattach

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

The Vgroup interface routines are used in a similar manner to the Vdata interface routines. Before performing operations on a vgroup, a calling program must call **Vstart** for every file to be accessed. **Vstart** initializes the internal vgroup structures in a file. **Vstart** takes one argument, the file identifier returned by **Hopen**, and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). Note that the **Vstart** routine is used by both the Vdata and Vgroup interfaces.

The calling program must also call one **Vattach** for every vgroup to be accessed. **Vattach** provides access to an individual vgroup for all read and write operations. **Vattach** takes three arguments: `file_id`, `vgroup_ref`, and `vg_access_mode`, and returns either a vgroup identifier or `FAIL` (or `-1`).

The argument `file_id` is the file identifier returned by **Hopen**. The parameter `vgroup_ref` is the reference number that identifies the vgroup to be accessed. Specifying `vgroup_ref` with a value of `-1` will create a new vgroup; specifying `vgroup_ref` with a nonexistent reference number will return an error code of `FAIL` (or `-1`); and specifying `vgroup_ref` with a valid reference number will initiate access to the corresponding vgroup.

When a new vgroup is created, it does not have any members. Additional operations must be performed to add other HDF data objects to the vgroup. Refer to Section 5.5 on page 194 for information.

To access an existing vdata, its reference number must be obtained. The Vgroup interface includes two routines for this purpose, **Vfind** and **Vgetid**. **Vfind** can be used to obtain the reference number of a vgroup when the vgroup's name is known. **Vgetid** can be used to obtain the reference number by sequentially traversing the file. These routines are discussed in Section 5.6.1.5 on page 209 and Section 5.6.1.2 on page 208.

The parameter `vg_access_mode` in **Vattach** specifies the type of access ("`r`" or "`w`") required for operations on the selected vgroup.

Multiple attaches may be made to a vgroup, which will result in several vgroup identifiers being assigned to the same vgroup. Termination must be properly handled as described in the next section.

The parameters of **Vstart** and **Vattach** are defined in Table 5B on page 194.

5.4.2 Terminating Access to Vgroups and Files: Vdetach and Vend

Successfully terminating access to a vgroup requires one **Vdetach** call for every **Vattach** call made. Similarly, successfully terminating access to the Vgroup interface requires one **Vend** call for every **Vstart** call made.

Vdetach terminates access to a vgroup by updating internal library structures and freeing all memory associated with the vgroup and allocated by **Vattach**. Once a vgroup is detached, its identifier is invalid and any attempts to access this vgroup identifier will result in an error condition. **Vdetach** takes one argument, `vgroup_id`, the vgroup identifier returned by **Vattach**, and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`).

Vend releases all internal data structures allocated by **Vstart**. Attempts to use the Vgroup interface identifier after calling **Vend** will produce errors. **Vend** takes one argument, `file_id`, the file identifier returned by **Hopen**, and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). Note that the first **Vend** call to a file must occur after all **Vdetach** calls for the vgroups in the same file have been made. Note also that the **Vend** routine is used by both the Vdata and Vgroup interfaces.

Hclose must be used to terminate access to the HDF file and only after all proper **Vend** calls are made. **Hclose** is described in Chapter 2, *HDF Fundamentals*.

The parameters of **Vdetach** and **Vend** are also defined in Table 5B.

TABLE 5B **Vstart, Vattach, Vdetach, and Vend Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vstart [intn] **(vfstart)**	file_id	int32	integer	File identifier
Vattach [int32] **(vfatch)**	file_id	int32	integer	File identifier
	vgroup_ref	int32	integer	Reference number for an existing vgroup or -1 to create a new one
	vg_access_mode	char *	character*(*)	Access mode of the vgroup operation
Vdetach [int32] **(vfdtch)**	vgroup_id	int32	integer	Vgroup identifier
Vend [intn] **(vfend)**	file_id	int32	integer	File identifier

5.5 Creating and Writing to a Vgroup

There are two steps involved in the creation of a vgroup: creating the vgroup and inserting data objects into it. Any HDF data object can be inserted into a vgroup. Creation and insertion operations are usually performed at the same time, but that is not required.

HDF provides two routines that insert an HDF data object into a vgroup, **Vaddtagref** and **Vinsert**. **Vaddtagref** can insert any HDF data object into a vgroup, but requires that the tag and reference number of the object be available. Refer to Section 2.2.2.1 on page 8 for the description of tags and reference numbers for HDF data objects. **Vinsert** only inserts a vdata or a vgroup to a vgroup, but only requires the identifier of the vdata or the vgroup.

Creating a vgroup with a member involves the following steps:

1. Open the HDF file.
2. Initialize the Vgroup interface.
3. Create the new vgroup.
4. Optionally assign a vgroup name.
5. Optionally assign a vgroup class.
6. Insert a data object.
7. Terminate access to the vgroup.
8. Terminate access to the Vgroup interface.
9. Close the HDF file.

These steps correspond to the following sequence of function calls:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            status = Vstart(file_id);
            vgroup_id = Vattach(file_id, vgroup_ref, vg_access_mode);
            status = Vsetname(vgroup_id, vgroup_name);
            status = Vsetclass(vgroup_id, vgroup_class);

            /* Use either Vinsert to add a vdata or a vgroup, or
               Vaddtagref to add any data object */
            num_of_tag_refs = Vaddtagref(vgroup_id, obj_tag, obj_ref);
      OR    obj_pos = Vinsert(vgroup_id, v_id);
```

```
              status = Vdetach(vgroup_id);
              status = Vend(file_id);
              status = Hclose(file_id);

FORTRAN:      file_id = hopen(filename, file_access_mode, num_dds_block)
              status = vfstart(file_id)
              vgroup_id = vfatch(file_id, vgroup_ref, vg_access_mode)
              status = vfsnam(vgroup_id, vdata_name)
              status = vfscls(vgroup_id, vdata_class)

C             Use either Vinsert to add a vdata or a vgroup, or Vaddtagref to
C             add any data object
              num_of_tag_refs = vfadtr(vgroup_id, obj_tag, obj_ref)
    OR        obj_pos = vfinsrt(vgroup_id, v_id)

              status = vfdtch(vgroup_id)
              status = vfend(file_id)
              status = hclose(file_id)
```

The parameter v_id in the calling sequence is either a vdata or vgroup identifier. The parameter vgroup_id is the vgroup identifier returned by **Vattach**.

When a new vgroup is created, the value of vgroup_ref must be set to -1 and the value of vg_access_mode must be "w".

5.5.1 Assigning a Vgroup Name and Class: Vsetname and Vsetclass

Vsetname assigns a name to a vgroup. The parameter vgroup_name is a character string with the name to be assigned to the vgroup. If **Vsetname** is not called, the vgroup name is set to a zero-length character string. A name may be assigned and reset any time after the vgroup is created.

Vsetclass assigns a class to a vgroup. The parameter vgroup_class is a character string with the class name to be assigned to the vgroup. If **Vsetclass** is not called, the vgroup class is set to a zero-length string. As with the vgroup names, the class may be set and reset at any time after the vgroup is created.

Vsetname and **Vsetclass** return either SUCCEED (or 0) or FAIL (or -1). The parameters of these routines are further described in Table 5C on page 196.

5.5.2 Inserting Any HDF Data Object into a Vgroup: Vaddtagref

Vaddtagref inserts HDF data objects into the vgroup identified by vgroup_id. HDF data objects may be added to a vgroup when the vgroup is created or at any point thereafter.

The parameters obj_tag and obj_ref in **Vaddtagref** are the tag and reference number, respectively, of the data object to be inserted into the vgroup. Note that duplicated tag and reference number pairs are allowed.

Vaddtagref returns the total number of tag and reference number pairs, i.e., the total number of data objects, in the vgroup if the operation is successful, and FAIL (or -1) otherwise. The parameters of **Vaddtagref** are further described in Table 5C.

5.5.3 Inserting a Vdata or Vgroup Into a Vgroup: Vinsert

Vinsert is a routine designed specifically for inserting vdatas or vgroups into a parent vgroup. To use **Vinsert**, you must provide the identifier of the parent vgroup, vgroup_id, as well as the identifier of the vdata or vgroup to be inserted, v_id.

The parameter `v_id` of **Vinsert** is either a vdata identifier or a vgroup identifier, depending on whether a vdata or vgroup is to be inserted.

Vinsert returns the index of the inserted vdata or vgroup if the operation is successful, and `FAIL` (or `-1`) otherwise. The parameters of **Vinsert** are further defined in Table 5C.

TABLE 5C **Vsetname, Vsetclass, Vaddtagref, and Vinsert Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vsetname [int32] **(vfsnam)**	vgroup_id	int32	integer	Vgroup identifier
	vgroup_name	char *	character*(*)	Vgroup name
Vsetclass [int32] **(vfscls)**	vgroup_id	int32	integer	Vgroup identifier
	vgroup_class	char *	character*(*)	Vgroup class
Vaddtagref [int32] **(vfadtr)**	vgroup_id	int32	integer	Vgroup identifier
	obj_tag	int32	integer	Tag of the data object to be inserted
	obj_ref	int32	integer	Reference number of the data object to be inserted
Vinsert [int32] **(vfinsrt)**	vgroup_id	int32	integer	Vgroup identifier
	v_id	int32	integer	Identifier of the vgroup or vdata to be inserted

EXAMPLE 1. **Creating HDF Files and Vgroups**

This example illustrates the use of **Hopen/hopen**, **Vstart/vfstart**, **Vattach/vfatch**, **Vdetach/vfdtch**, **Vend/vfend**, and **Hclose/hclose** to create and to access two vgroups in an HDF file.

The program creates the HDF file, named "Two_Vgroups.hdf", and two vgroups stored in the file. Note that, in this example, the program only create two empty vgroups.

C:

```
#include "hdf.h"

#define  FILE_NAME    "Two_Vgroups.hdf"

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

   intn  status_n;      /* returned status for functions returning an intn  */
   int32 status_32,     /* returned status for functions returning an int32 */
         vgroup_ref = -1,
         vgroup1_id, vgroup2_id, file_id;

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

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

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

   /*
   * Create the first vgroup.  Note that the vgroup reference number is set
   * to -1 for creating and the access mode is "w" for writing.
   */
   vgroup1_id = Vattach (file_id, vgroup_ref, "w");

   /*
   * Create the second vgroup.
   */
   vgroup2_id = Vattach (file_id, vgroup_ref, "w");

   /*
   * Any operations on the vgroups.
   */

   /*
   * Terminate access to the first vgroup.
   */
   status_32 = Vdetach (vgroup1_id);

   /*
   * Terminate access to the second vgroup.
   */
   status_32 = Vdetach (vgroup2_id);

   /*
   * Terminate access to the V interface and close the HDF file.
   */
   status_n = Vend (file_id);
   status_n = Hclose (file_id);
}
```

FORTRAN:

```
      program  create_vgroup
      implicit none
C
C     Parameter declaration
C
      character*15 FILE_NAME
C
      parameter (FILE_NAME = ’Two_Vgroups.hdf’)
      integer DFACC_CREATE
      parameter (DFACC_CREATE = 4)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id
      integer vgroup1_id, vgroup2_id, 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
```

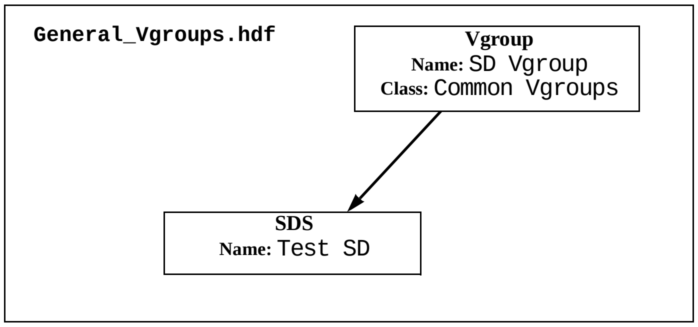
```
C     Initialize the V interface.
C
      status = vfstart(file_id)
C
C     Create the first vgroup. Note that the vgroup reference number is set
C     to -1 for creating and the access mode is ’w’ for writing.
C
      vgroup_ref = -1
      vgroup1_id = vfatch(file_id, vgroup_ref, ’w’)
C
C     Create the second vgroup.
C
      vgroup2_id = vfatch(file_id, vgroup_ref, ’w’)
C
C     Any operations on the vgroups.
C
C     ..............................
C
C     Terminate access to the first vgroup.
C
      status = vfdtch(vgroup1_id)
C
C     Terminate access to the second vgroup.
C
      status = vfdtch(vgroup2_id)
C
C     Terminate access to the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

EXAMPLE 2.

Adding an SDS to a New Vgroup

This example illustrates the use of **Vaddtagref/vfadtr** to add an HDF data object, an SDS specifically, to a vgroup.

In this example, the program first creates the HDF file "General_Vgroups.hdf", then an SDS in the SD interface, and a vgroup in the Vgroup interface. The SDS is named "Test SD" and is a one-dimensional array of type int32 of 10 elements. The vgroup is named "SD Vgroup" and is of class "Common Vgroups". The program then adds the SDS to the vgroup using **Vaddtagref/vfadtr**. Notice that, when the operations are complete, the program explicitly terminates access to the SDS, the vgroup, the SD interface, and the Vgroup interface before closing the HDF file. Refer to Chapter 3, *Scientific Data Sets (SD API)* for the discussion of the SD routines used in this example.



C:

```
#include   "hdf.h"      /* Note: in this example, hdf.h can be omitted...*/
#include   "mfhdf.h"    /* ...since mfhdf.h already includes hdf.h */

#define  FILE_NAME    "General_Vgroups.hdf"
#define  SDS_NAME     "Test SD"
#define  VG_NAME      "SD Vgroup"
#define  VG_CLASS     "Common Vgroups"

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

   intn   status_n;     /* returned status for functions returning an intn  */
   int32  status_32,    /* returned status for functions returning an int32 */
          sd_id,        /* SD interface identifier */
          sds_id,       /* data set identifier */
          sds_ref,      /* reference number of the data set */
          dim_sizes[1], /* dimension of the data set - only one */
          rank = 1,     /* rank of the data set array */
          vgroup_id,    /* vgroup identifier */
          file_id;      /* HDF file identifier, same for V interface */

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

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

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

   /*
   * Initialize the SD interface.
   */
   sd_id = SDstart (FILE_NAME, DFACC_WRITE);

   /*
   * Set the size of the SDS’s dimension.
   */
   dim_sizes[0] = 10;

   /*
   * Create the SDS.
   */
   sds_id = SDcreate (sd_id, SDS_NAME, DFNT_INT32, rank, dim_sizes);

   /*
   * Create a vgroup and set its name and class.
   */
   vgroup_id = Vattach (file_id, -1, "w");
   status_32 = Vsetname (vgroup_id, VG_NAME);
   status_32 = Vsetclass (vgroup_id, VG_CLASS);

   /*
   * Obtain the reference number of the SDS using its identifier.
   */
   sds_ref = SDidtoref (sds_id);
   /*
   * Add the SDS to the vgroup.  Note: the tag DFTAG_NDG is used
   * when adding an SDS.  Refer to Appendix A for the entire list of tags.
   */
   status_32 = Vaddtagref (vgroup_id, DFTAG_NDG, sds_ref);

   /*
   * Terminate access to the SDS and to the SD interface.
   */
   status_n = SDendaccess (sds_id);
   status_n = SDend (sd_id);

   /*
   * Terminate access to the vgroup and to the V interface, and
   * close the HDF file.
   */
   status_32 = Vdetach (vgroup_id);
   status_n = Vend (file_id);
   status_n = Hclose (file_id);
}
```

FORTRAN:

```
      program  add_SDS_to_a_vgroup
      implicit none
C
C     Parameter declaration
C
      character*19 FILE_NAME
      character*7  SDS_NAME
      character*9  VG_NAME
      character*13 VG_CLASS
C
      parameter (FILE_NAME = 'General_Vgroups.hdf',
     +           SDS_NAME  = 'Test SD',
     +           VG_NAME   = 'SD Vgroup',
     +           VG_CLASS  = 'Common Vgroups')
      integer DFACC_CREATE, DFACC_WRITE
      parameter (DFACC_CREATE = 4, DFACC_WRITE = 2)
      integer DFNT_INT32
      parameter (DFNT_INT32 = 24)
      integer DFTAG_NDG
      parameter (DFTAG_NDG = 720)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfsnam, vfscls, vfadtr, vfdtch, vfend
      integer sfstart, sfcreate, sfid2ref, sfendacc, sfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id
      integer vgroup_id
      integer sd_id, sds_id, sds_ref
      integer dim_sizes(1), rank
C
C**** End of variable declaration ************************************
C
C
```

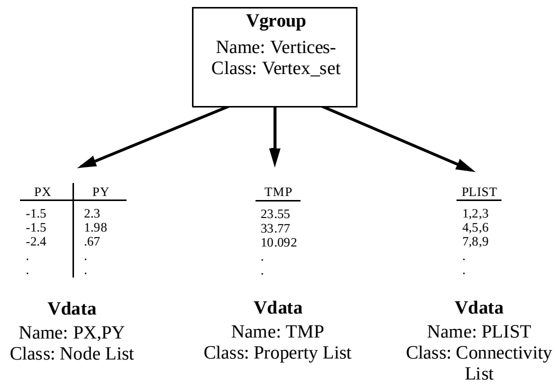
```
C     Create the HDF file.
C
      file_id = hopen(FILE_NAME, DFACC_CREATE, 0)
C
C     Initialize the V interface.
C
      status = vfstart(file_id)

C
C     Initialize SD interface.
C
      sd_id = sfstart(FILE_NAME, DFACC_WRITE)
C
C     Set the rank and the size of SDS’s dimension.
C
      rank = 1
      dim_sizes(1) = 10
C
C     Create the SDS.
C
      sds_id = sfcreate(sd_id, SDS_NAME, DFNT_INT32, rank, dim_sizes)
C
C     Create a vgroup and set its name and class.
C
      vgroup_id = vfatch(file_id, -1 , ’w’)
      status    = vfsnam(vgroup_id, VG_NAME)
      status    = vfscls(vgroup_id, VG_CLASS)
C
C     Obtain the reference number of the SDS using its identifier.
C
      sds_ref = sfid2ref(sds_id)
C
C     Add the SDS to the vgroup. Note: the tag DFTAG_NDG is used
C    when adding an SDS.  Refer to HDF Reference Manual, Section III, Table 3K,
C     for the entire list of tags.
C
      status = vfadtr(vgroup_id, DFTAG_NDG, sds_ref)
C
C     Terminate access to the SDS and to the SD interface.
C
      status = sfendacc(sds_id)
      status = sfend(sd_id)
C
C     Terminate access to the vgroup.
C
      status = vfdtch(vgroup_id)
C
C     Terminate access to the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

EXAMPLE 3.

Adding Three Vdatas into a Vgroup

This example illustrates the use of **Vinsert/vfinsrt** to add a vdata to a vgroup. Note that **Vaddtagref/vfadtrf**, used in the previous example, performs the same task and only differs in the argument list.

In this example, the program creates three vdatas and a vgroup in the existing HDF file "General_Vgroups.hdf" then adds the three vdatas to the vgroup. Notice that the vdatas and the vgroup are created in the same interface that is initialized by the call **Vstart/vfstart**. The first vdata is named "X,Y Coordinates" and has two order-1 fields of type float32. The second vdata is named "Temperature" and has one order-1 field of type float32. The third vdata is named "Node List" and has one order-3 field of type int16. The vgroup is named "Vertices" and is of class "Vertex Set". The program uses **Vinsert/vfinsrt** to add the vdatas to the vgroup using the vdata identifiers. Refer to Chapter 4, *Vdatas (VS API)*, for the discussion of the VS routines used in this example.



C:

```
#include "hdf.h"

#define  FILE_NAME         "General_Vgroups.hdf"
#define  N_RECORDS         30       /* number of records in the vdatas */
#define  ORDER             3        /* order of field FIELD_VD2 */
#define  VG_NAME           "Vertices"
#define  VG_CLASS          "Vertex Set"
#define  VD1_NAME          "X,Y Coordinates"   /* first vdata to hold X,Y...*/
#define  VD1_CLASS         "Position"          /*...values of the vertices */
#define  VD2_NAME         "Temperature"       /* second vdata to hold the...*/
#define  VD2_CLASS         "Property List"     /*...temperature field */
#define  VD3_NAME          "Node List"         /* third vdata to hold...*/
#define  VD3_CLASS         "Mesh"              /*...the list of nodes */
#define  FIELD1_VD1        "PX"    /* first field of first vdata - X values */
#define  FIELD2_VD1        "PY"/* second field of first vdata - Y values */
#define  FIELD_VD2         "TMP"/* field of third vdata */
#define  FIELD_VD3         "PLIST"/* field of second vdata */
#define  FIELDNAME_LIST    "PX,PY" /* field name list for first vdata */
/* Note that the second and third vdatas can use the field names as
   the field name lists unless more fields are added to a vdata.
   Then a field name list is needed for that vdata */

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, vgroup_id,
         vdata1_id, vdata2_id, vdata3_id;
int32    num_of_records,           /* number of records actually written */
         vd_index;                 /* position of a vdata in the vgroup  */
int8     i, j, k = 0;
float32  pxy[N_RECORDS][2] =       /* buffer for data of the first vdata */
                    {-1.5, 2.3, -1.5, 1.98, -2.4, .67,
                  -3.4, 1.46, -.65, 3.1, -.62, 1.23,
                  -.4, 3.8, -3.55, 2.3, -1.43, 2.44,
                  .23, 1.13, -1.4, 5.43, -1.4, 5.8,
                  -3.4, 3.85, -.55, .3, -.21, 1.22,
                  -1.44, 1.9, -1.4, 2.8, .94, 1.78,
                  -.4, 2.32, -.87, 1.99, -.54, 4.11,
                  -1.5, 1.35, -1.4, 2.21, -.22, 1.8,
                  -1.1, 4.55, -.44, .54, -1.11, 3.93,
                  -.76, 1.9, -2.34, 1.7, -2.2, 1.21};
float32  tmp[N_RECORDS];          /* buffer for data of the second vdata */
int16    plist[N_RECORDS][3];     /* buffer for data of the third vdata */

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

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

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

/*
* Buffer the data for the second and third vdatas.
*/
for (i = 0; i < N_RECORDS; i++)
   for (j = 0; j < ORDER; j++)
      plist[i][j] = ++k;

for (i = 0; i < N_RECORDS; i++)
   tmp[i] = i * 10.0;

/*
* Create the vgroup then set its name and class.  Note that the vgroup's
* reference number is set to -1 for creating and the access mode is "w" for
* writing.
*/
vgroup_id = Vattach (file_id, -1, "w");
status_32 = Vsetname (vgroup_id, VG_NAME);
status_32 = Vsetclass (vgroup_id, VG_CLASS);

/*
* Create the first vdata then set its name and class. Note that the vdata's
* reference number is set to -1 for creating and the access mode is "w" for
* writing.
*/
vdata1_id = VSattach (file_id, -1, "w");
status_32 = VSsetname (vdata1_id, VD1_NAME);
status_32 = VSsetclass (vdata1_id, VD1_CLASS);
```

```
   /*
   * Introduce and define the fields of the first vdata.
   */
   status_n = VSfdefine (vdata1_id, FIELD1_VD1, DFNT_FLOAT32, 1);
   status_n = VSfdefine (vdata1_id, FIELD2_VD1, DFNT_FLOAT32, 1);
   status_n = VSsetfields (vdata1_id, FIELDNAME_LIST);

   /*
   * Write the buffered data into the first vdata with full interlace mode.
   */
   num_of_records = VSwrite (vdata1_id, (uint8 *)pxy, N_RECORDS,
                             FULL_INTERLACE);

   /*
   * Insert the vdata into the vgroup using its identifier.
   */
   vd_index = Vinsert (vgroup_id, vdata1_id);

   /*
   * Detach from the first vdata.
   */
   status_32 = VSdetach (vdata1_id);

   /*
   * Create, write, and insert the second vdata to the vgroup using
   * steps similar to those used for the first vdata.
   */
   vdata2_id = VSattach (file_id, -1, "w");
   status_32 = VSsetname (vdata2_id, VD2_NAME);
   status_32 = VSsetclass (vdata2_id, VD2_CLASS);
   status_n = VSfdefine (vdata2_id, FIELD_VD2, DFNT_FLOAT32, 1);
   status_n = VSsetfields (vdata2_id, FIELD_VD2);
   num_of_records = VSwrite (vdata2_id, (uint8 *)tmp, N_RECORDS,
                             FULL_INTERLACE);
   vd_index = Vinsert (vgroup_id, vdata2_id);
   status_32 = VSdetach (vdata2_id);

   /*
   * Create, write, and insert the third vdata to the vgroup using
   * steps similar to those used for the first and second vdatas.
   */
   vdata3_id = VSattach (file_id, -1, "w");
   status_32 = VSsetname (vdata3_id, VD3_NAME);
   status_32 = VSsetclass (vdata3_id, VD3_CLASS);
   status_n = VSfdefine (vdata3_id, FIELD_VD3, DFNT_INT16, 3);
   status_n = VSsetfields (vdata3_id, FIELD_VD3);
   num_of_records = VSwrite (vdata3_id, (uint8 *)plist, N_RECORDS,
                             FULL_INTERLACE);
   vd_index = Vinsert (vgroup_id, vdata3_id);
   status_32 = VSdetach (vdata3_id);

   /*
   * Terminate access to the vgroup "Vertices".
   */
   status_32 = Vdetach (vgroup_id);

   /*
   * Terminate access to the V interface and close the HDF file.
   */
   status_n = Vend (file_id);
   status_n = Hclose (file_id);
}
```

FORTRAN:

```
      program  add_vdatas_to_a_vgroup
      implicit none
C
C     Parameter declaration
C
      character*19 FILE_NAME
      character*8  VG_NAME
      character*10 VG_CLASS
      character*15 VD1_NAME
      character*8  VD1_CLASS
      character*11 VD2_NAME
      character*13 VD2_CLASS
      character*9  VD3_NAME
      character*4  VD3_CLASS
C
      parameter (FILE_NAME = ’General_Vgroups.hdf’,
     +           VG_NAME   = ’Vertices’,
     +           VG_CLASS  = ’Vertex Set’)
      parameter (VD1_NAME  = ’X,Y Coordinates’,
     +           VD2_NAME  = ’Temperature’,
     +           VD3_NAME  = ’Node List’)
      parameter (VD1_CLASS = ’Position’,
     +           VD2_CLASS = ’Property List’,
     +           VD3_CLASS = ’Mesh’)
      character*2 FIELD1_VD1
      character*2 FIELD2_VD1
      character*3 FIELD_VD2
      character*4 FIELD_VD3
      character*5 FIELDNAME_LIST
      parameter (FIELD1_VD1 = ’PX’,
     +           FIELD2_VD1 = ’PY’,
     +           FIELD_VD2  = ’TMP’,
     +           FIELD_VD3  = ’PLIST’,
     +           FIELDNAME_LIST = ’PX,PY’)
      integer N_RECORDS
      parameter (N_RECORDS = 30)

      integer  DFACC_WRITE
      parameter (DFACC_WRITE = 2)
      integer DFNT_FLOAT32, DFNT_INT16
      parameter (DFNT_FLOAT32 = 5, DFNT_INT16 = 22)
      integer FULL_INTERLACE
      parameter (FULL_INTERLACE = 0)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfsnam, vfscls, vfinsrt, vfdtch, vfend
      integer vsfatch, vsfsnam, vsfscls, vsffdef, vsfsfld,
     +        vsfwrt, vsfwrtc, vsfdtch

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id
      integer vgroup_id
      integer vdata1_id, vdata2_id, vdata3_id, vd_index
      integer num_of_records
      integer i, j, k
      real    pxy(2,N_RECORDS), tmp(N_RECORDS)
      integer plist(3,N_RECORDS)
      data pxy /-1.5, 2.3, -1.5, 1.98, -2.4, .67,
     +          -3.4, 1.46, -.65, 3.1, -.62, 1.23,
     +          -.4, 3.8, -3.55, 2.3, -1.43, 2.44,
     +          .23, 1.13, -1.4, 5.43, -1.4, 5.8,
     +          -3.4, 3.85, -.55, .3, -.21, 1.22,
     +          -1.44, 1.9, -1.4, 2.8, .94, 1.78,
     +          -.4, 2.32, -.87, 1.99, -.54, 4.11,
     +          -1.5, 1.35, -1.4, 2.21, -.22, 1.8,
     +          -1.1, 4.55, -.44, .54, -1.11, 3.93,
     +          -.76, 1.9, -2.34, 1.7, -2.2, 1.21/
C
C**** End of variable declaration ************************************
C
C
C     Open the HDF file for writing.
C
      file_id = hopen(FILE_NAME, DFACC_WRITE, 0)
C
C     Initialize the V interface.
C
      status = vfstart(file_id)
C
C     Buffer the data for the third and second vdatas.
C
      do 20 i = 1, N_RECORDS
         do 10 j = 1, 3
            plist(j,i) = k
            k = k+1
10       continue
20    continue
      do 30 i = 1, N_RECORDS
         tmp(i) = (i-1) * 10.0
30    continue
C
C     Create a vgroup and set its name and class.
C     Note that the vgroup's reference number is set to -1 for creating
C     and the access mode is 'w' for writing.
C
      vgroup_id = vfatch(file_id, -1 , 'w')
      status    = vfsnam(vgroup_id, VG_NAME)
      status    = vfscls(vgroup_id, VG_CLASS)
C
C     Create the first vdata then set its name and class. Note that the vdata's
C     reference number is set to -1 for creating and the access mode is 'w' for
C     writing.
C
      vdata1_id = vsfatch(file_id, -1, 'w')
      status = vsfsnam(vdata1_id, VD1_NAME)
      status = vsfscls(vdata1_id, VD1_CLASS)
C
C     Introduce and define the fields of the first vdata.
C
      status = vsffdef(vdata1_id, FIELD1_VD1, DFNT_FLOAT32, 1)
      status = vsffdef(vdata1_id, FIELD2_VD1, DFNT_FLOAT32, 1)
      status = vsfsfld(vdata1_id, FIELDNAME_LIST)
C
C     Write the buffered data into the first vdata.
C
      num_of_records = vsfwrt(vdata1_id, pxy, N_RECORDS,
     +                        FULL_INTERLACE)
C
C     Insert the vdata into the vgroup using its identifier.
```

```
C
      vd_index = vfinsrt(vgroup_id, vdata1_id)
C
C     Detach from the first vdata.
C
      status = vsfdtch(vdata1_id)
C
C     Create, write, and insert the second vdata to the vgroup using
C     steps similar to those used for the first vdata.
C
      vdata2_id = vsfatch(file_id, -1, ’w’)
      status = vsfsnam(vdata2_id, VD2_NAME)
      status = vsfscls(vdata2_id, VD2_CLASS)
      status = vsffdef(vdata2_id, FIELD_VD2, DFNT_FLOAT32, 1)
      status = vsfsfld(vdata2_id, FIELD_VD2)
      num_of_records = vsfwrt(vdata2_id, tmp, N_RECORDS,
     +                        FULL_INTERLACE)
      vd_index = vfinsrt(vgroup_id, vdata2_id)
      status = vsfdtch(vdata2_id)
C
C     Create, write, and insert the third vdata to the vgroup using
C     steps similar to those used for the first and second vdatas.
C
      vdata3_id = vsfatch(file_id, -1, ’w’)
      status = vsfsnam(vdata3_id, VD3_NAME)
      status = vsfscls(vdata3_id, VD3_CLASS)
      status = vsffdef(vdata3_id, FIELD_VD3, DFNT_INT16, 3)
      status = vsfsfld(vdata3_id, FIELD_VD3)
      num_of_records = vsfwrtc(vdata3_id, plist, N_RECORDS,
     +                        FULL_INTERLACE)
      vd_index = vfinsrt(vgroup_id, vdata3_id)
      status = vsfdtch(vdata3_id)

C
C     Terminate access to the vgroup ’Vertices’.
C
      status = vfdtch(vgroup_id)
C
C     Terminate access to the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

5.6 Reading from Vgroups

Reading from vgroups is more complicated than writing to vgroups. The process of reading from vgroups involves two steps: locating the appropriate vgroup and obtaining information about the member or members of a vgroup.

Reading from vgroups is more complicated than writing to vgroups. This section describes routines that locate the appropriate vgroup and obtain information about the member or members of a vgroup.

5.6.1 Locating Vgroups and Obtaining Vgroup Information

There are several routines provided for the purpose of locating a particular vgroup, each corresponding to an identifying aspect of a vgroup. These aspects include whether the vgroup has vgroups included in it, the identification of the vgroup in the file based on its reference number, and the name and class name of the vgroup. The routines are described in the following subsections.

5.6.1.1 Locating Lone Vgroups: Vlone

A ***lone vgroup*** is one that is not a member of any other vgroups, i.e., not linked with any other vgroups. **Vlone** searches the file specified by the parameter `file_id` and retrieves the reference numbers of lone vgroups in the file. This routine is useful for locating unattached vgroups in a file or the vgroups at the top of a grouping hierarchy. The syntax of **Vlone** is as follows:

```
C:          num_of_lones = Vlone(file_id, ref_array, maxsize);

FORTRAN:    num_of_lones = vflone(file_id, ref_array, maxsize)
```

The parameter `ref_array` is an array allocated to hold the reference numbers of the found vgroups. The argument `maxsize` specifies the maximum size of `ref_array`. At most `maxsize` reference numbers will be retrieved in `ref_array`. The value of `max_size`, the space allocated for `ref_array`, depends on how many lone vgroups are expected to be found.

To use dynamic memory instead of allocating an unnecessarily large array (i.e., one that will hold the maximum possible number of reference numbers), call **Vlone** twice. In the first call to **Vlone**, set `maxsize` to a small value, for example, 0 or 1, then use the returned value (the total number of lone vgroups in the file) to allocate memory for `ref_array`. This array is then passed into the second call to **Vlone**.

Vlone returns the total number of lone vgroups or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5D on page 208.

5.6.1.2 Sequentially Searching for a Vgroup: Vgetid

Vgetid sequentially searches through an HDF file to obtain the reference number of the vgroup immediately following the vgroup specified by the reference number, `vgroup_ref`. The syntax of **Vgetid** is as follows:

```
C:          ref_num = Vgetid(file_id, vgroup_ref);

FORTRAN:    ref_num = vfgid(file_id, vgroup_ref)
```

To initiate a search, **Vgetid** may be called with `vgroup_ref` set to `-1`. Doing so returns the reference number of the first vgroup in the file. Any attempt to search past the last vgroup in a file will cause **Vgetid** to return a value of `FAIL` (or `-1`).

Vgetid returns a vgroup reference number or `FAIL` (or `-1`). The parameters of **Vgetid** are further defined in Table 5D.

TABLE 5D **Vlone and Vgetid Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vlone [int32] **(vflone)**	file_id	int32	integer	File identifier
	ref_array	int32 *	integer (*)	Buffer for the reference numbers of lone vgroups
	maxsize	int32	integer	Maximum number of vgroups to store in `ref_array`
Vgetid [int32] **(vfgid)**	file_id	int32	integer	File identifier
	vgroup_ref	int32	integer	Reference number of the current vgroup

5.6.1.3 Obtaining the Name of a Vgroup: Vgetname

Vgetname retrieves the name of the vgroup identified by the parameter `vgroup_id` into the parameter `vgroup_name`. The syntax of **Vgetname** is as follows:

```
C:         status = Vgetname(vgroup_id, vgroup_name);

FORTRAN:   status = vfgnam(vgroup_id, vgroup_name)
```

The maximum length of the vgroup name is defined by `VGNAMELENMAX` (or `64`).

Vgetname returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5E on page 209.

5.6.1.4 Obtaining the Class Name of a Vgroup: Vgetclass

Vgetclass retrieves the class name of the vgroup specified by the parameter `vgroup_id` into the parameter `vgroup_class`. The syntax of **Vgetclass** is as follows:

```
C:         status = Vgetclass(vgroup_id, vgroup_class);

FORTRAN:   status = vfgcls(vgroup_id, vgroup_class)
```

The maximum length of the class name is defined by `VGNAMELENMAX` (or `64`).

Vgetclass returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5E.

TABLE 5E **Vgetname and Vgetclass Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vgetname [int32] **(vfgnam)**	vgroup_id	int32	integer	Vgroup identifier
	vgroup_name	char *	character*(*)	Buffer for the name of the vgroup
Vgetclass [int32] **(vfgcls)**	vgroup_id	int32	integer	Vgroup identifier
	vgroup_class	char *	character*(*)	Buffer for the vgroup class

5.6.1.5 Locating a Vgroup Given Its Name: Vfind

Vfind searches the file identified by `file_id` for a vgroup with the name specified by the parameter `vgroup_name`. The syntax for **Vfind** is as follows:

```
C:         vgroup_ref = Vfind(file_id, vgroup_name);

FORTRAN:   vgroup_ref = vfind(file_id, vgroup_name)
```

Vfind returns the reference number of the vgroup if one is found, or `0` otherwise. If more than one vgroup has the same name, **Vfind** will return the reference number of the first one.

The parameters of **Vfind** are further defined in Table 5F.

5.6.1.6 Locating a Vgroup Given Its Class Name: Vfindclass

Vfindclass searches the file identified by `file_id` for a vgroup with the class name specified by the parameter `vgroup_class`. The syntax of **Vfindclass** is as follows:

```
C:          vgroup_ref = Vfindclass(file_id, vgroup_class);

FORTRAN:    vgroup_ref = vfndcls(file_id, vgroup_class)
```

Vfindclass returns the reference number of the vgroup if one is found, or `0` otherwise. If more than one vgroup has the same class name, **Vfindclass** will return the reference number of the first one.

The parameters of **Vfindclass** are further defined in Table 5F.

TABLE 5F **Vfind and Vfindclass Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vfind [int32] **(vfind)**	file_id	int32	integer	File identifier
	vgroup_name	char *	character*(*)	Buffer for the name of the vgroup
Vfindclass [int32] **(vfndcls)**	file_id	int32	integer	File identifier
	vgroup_class	char *	character*(*)	Buffer for the vgroup class

EXAMPLE 4. **Obtaining Information about Lone Vgroups**

This example illustrates the use of **Vlone/vflone** to obtain the list of reference numbers of all lone vgroups in the file and the use of **Vgetname/vfgnam** and **Vgetclass/vfgcls** to obtain the name and the class of a vgroup.

In this example, the program calls **Vlone/vflone** twice. The first call is to obtain the number of lone vgroups in the file so that sufficient space can be allocated; the later call is to obtain the actual reference numbers of the lone vgroups. The program then goes through the list of lone vgroup reference numbers to get and display the name and class of each lone vgroup. The file used in this example is "General_Vgroups.hdf".

C:

```
#include "hdf.h"

#define  FILE_NAME   "General_Vgroups.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, vgroup_id;
   int32  lone_vg_number,      /* current lone vgroup number */
          num_of_lones = 0;    /* number of lone vgroups */
   int32 *ref_array;    /* buffer to hold the ref numbers of lone vgroups   */
   char   vgroup_name[VGNAMELENMAX], vgroup_class[VGNAMELENMAX];

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

   /*
```

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

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

/*
* Get and print the names and class names of all the lone vgroups.
* First, call Vlone with num_of_lones set to 0 to get the number of
* lone vgroups in the file, but not to get their reference numbers.
*/
num_of_lones = Vlone (file_id, NULL, num_of_lones );

/*
* Then, if there are any lone vgroups,
*/
if (num_of_lones > 0)
{
   /*
   * use the num_of_lones returned to allocate sufficient space for the
   * buffer ref_array to hold the reference numbers of all lone vgroups,
   */
   ref_array = (int32 *) malloc(sizeof(int32) * num_of_lones);

   /*
   * and call Vlone again to retrieve the reference numbers into
   * the buffer ref_array.
   */
   num_of_lones = Vlone (file_id, ref_array, num_of_lones);

   /*
   * Display the name and class of each lone vgroup.
   */
   printf ("Lone vgroups in this file are:\n");
   for (lone_vg_number = 0; lone_vg_number < num_of_lones;
                                                         lone_vg_number++)
   {
      /*
      * Attach to the current vgroup then get and display its
      * name and class. Note: the current vgroup must be detached before
      * moving to the next.
      */
      vgroup_id = Vattach (file_id, ref_array[lone_vg_number], "r");
      status_32 = Vgetname (vgroup_id, vgroup_name);
      status_32 = Vgetclass (vgroup_id, vgroup_class);
      printf ("   Vgroup name %s and class %s\n", vgroup_name,
                  vgroup_class);
      status_32 = Vdetach (vgroup_id);
   } /* for */
} /* if */

/*
* Terminate access to the V interface and close the file.
*/
status_n = Vend (file_id);
status_n = Hclose (file_id);

/*
* Free the space allocated by this program.
*/
```

```
   free (ref_array);
}
```

FORTRAN:

```
      program  getinfo_about_vgroup
      implicit none
C
C     Parameter declaration
C
      character*19 FILE_NAME
C
      parameter (FILE_NAME = 'General_Vgroups.hdf')
      integer DFACC_READ
      parameter (DFACC_READ = 1)
      integer SIZE
      parameter(SIZE = 10)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfgnam, vfgcls, vflone, vfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id
      integer vgroup_id
      integer lone_vg_number, num_of_lones
      character*64 vgroup_name, vgroup_class
      integer ref_array(SIZE)
      integer i
C
C**** End of variable declaration ************************************
C
C
C     Initialize ref_array.
C
      do 10 i = 1, SIZE
         ref_array(i) = 0
10    continue
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 and print the name and class name of all lone vgroups.
C     First, call vflone with num_of_lones set to 0 to get the number of
C     lone vgroups in the file and check whether size of ref_array is
C     big enough to hold reference numbers of ALL lone groups.
C     If ref_array is not big enough, exit the program after displaying an
C     informative message.
C
      num_of_lones = 0
      num_of_lones = vflone(file_id, ref_array, num_of_lones)
      if (num_of_lones .gt. SIZE) then
      write(*,*) num_of_lones, 'lone vgroups is found'
      write(*,*) 'increase the size of ref_array to hold reference '
      write(*,*) ’numbers of all lone vgroups in the file’
      stop
      endif
C
C     If there are any lone groups in the file,
C
      if (num_of_lones .gt. 0) then
C
C     call vflone again to retrieve the reference numbers into ref_array.
C
      num_of_lones = vflone(file_id, ref_array, num_of_lones)
C
C     Display the name and class of each vgroup.
C
      write(*,*) ’Lone vgroups in the file are:’

      do 20 lone_vg_number = 1, num_of_lones
C
C     Attach to the current vgroup, then get and display its name and class.
C     Note: the current vgroup must be detached before moving to the next.
C
      vgroup_name = ’ ’
      vgroup_class = ’ ’
      vgroup_id = vfatch(file_id, ref_array(lone_vg_number), ’r’)
      status    = vfgnam(vgroup_id, vgroup_name)
      status    = vfgcls(vgroup_id, vgroup_class)
      write(*,*) ’Vgroup name ’ ,  vgroup_name
      write(*,*) ’Vgroup class ’ , vgroup_class
      write(*,*)
      status = vfdtch(vgroup_id)
20    continue

      endif
C
C     Terminate access to the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

5.6.2 Obtaining Information about the Contents of a Vgroup

This section describes the Vgroup interface routines that allow the user to obtain various information about the contents of vgroups.

5.6.2.1 Obtaining the Number of Objects in a Vgroup: Vntagrefs

Vntagrefs returns the number of tag/reference number pairs (i.e., the number of vgroup members) stored in the specified vgroup. The syntax of **Vntagrefs** is as follows:

```
C:          num_of_tagrefs = Vntagrefs(vgroup_id);

FORTRAN:    num_of_tagrefs = vfntr(vgroup_id)
```

Vntagrefs can be used together with **Vgettagrefs** or **Vgettagref** to identify the data objects linked to a given vgroup.

Vntagrefs returns 0 or a positive number representing the number of HDF data objects linked to the vgroup if successful, or `FAIL` (or `-1`) otherwise. The parameter of **Vntagrefs** is further defined in Table 5G on page 214.

5.6.2.2 Obtaining the Tag/Reference Number Pair of a Data Object within a Vgroup : Vgettagref

Vgettagref retrieves the tag/reference number pair of a specified data object stored within the vgroup identified by the parameter `vgroup_id`. The syntax of **Vgettagref** is as follows:

```
C:         status = Vgettagref(vgroup_id, index, &obj_tag, &obj_ref);

FORTRAN:   status = vfgttr(vgroup_id, index, obj_tag, obj_ref)
```

Vgettagref stores the tag and reference number in the parameters `obj_tag` and `obj_ref`, respectively. The parameter `index` specifies the location of the data object within the vgroup and is zero-based.

Often, this routine is called in a loop to identify the tag/reference number pair of each data object belong to a vgroup. In this case, **Vntagrefs** is used to obtain the loop boundary.

Vgettagref returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5G on page 214.

5.6.2.3 Obtaining the Tag/Reference Number Pairs of Data Objects in a Vgroup: Vgettagrefs

Vgettagrefs retrieves the tag/reference number pairs of the members of a vgroup and returns the number of pairs retrieved. The syntax of **Vgettagrefs** is as follows:

```
C:         num_of_pairs = Vgettagrefs(vgroup_id, tag_array, ref_array,
                          maxsize);

FORTRAN:   num_of_pairs = vfgttrs(vgroup_id, tag_array, ref_array, max-
                          size)
```

Vgettagrefs stores the tags into the array `tag_array` and the reference numbers into the array `ref_array`. The parameter `maxsize` specifies the maximum number of tag/reference number pairs to return, therefore each array must be at least `maxsize` in size.

Vgettagrefs can be used to obtain the value of `maxsize` if the tag/reference number pairs for all members of the vgroup are desired. To do this, set `maxsize` to 1 in the first call to **Vgettagrefs**.

Vgettagrefs returns the number of tag/reference number pairs or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5G.

TABLE 5G **Vntagrefs, Vgettagref, and Vgettagrefs Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vntagrefs [int32] **(vfntr)**	vgroup_id	int32	integer	Vgroup identifier
Vgettagref [intn] **(vfgttr)**	vgroup_id	int32	integer	Vgroup identifier
	index	int32	integer	Index of the tag/reference number pair to be retrieved
	obj_tag	int32 *	integer	Tag of the data object
	obj_ref	int32 *	integer	Reference number of the data object

Vgettagrefs [int32] **(vfgttrs)**	vgroup_id	int32	integer	Vgroup identifier
	tag_array	int32 []	integer (*)	Buffer for the returned tags
	ref_array	int32 []	integer (*)	Buffer for the returned reference numbers
	maxsize	int32	integer	Maximum number of tag/reference number pairs to be returned

5.6.2.4 Testing Whether a Data Object Belongs to a Vgroup: Vinqtagref

Vinqtagref determines whether a data object is a member of the vgroup specified by the parameter `vgroup_id`. The syntax of **Vinqtagref** is as follows:

```
C:          true_false = Vinqtagref(vgroup_id, obj_tag, obj_ref);

FORTRAN:    true_false = vfinqtr(vgroup_id, obj_tag, obj_ref)
```

The data object is specified by its tag/reference number pair in the parameters `obj_tag` and `obj_ref`. **Vinqtagref** returns `TRUE` (or `1`) if the object belongs to the vgroup, and `FALSE` (or `0`) otherwise. The parameters of this routine are further defined in Table 5H on page 215.

5.6.2.5 Testing Whether a Data Object within a Vgroup is a Vgroup: Visvg

Visvg determines whether the data object specified by its reference number, `obj_ref`, is a vgroup and is a member of the vgroup identified by the parameter `vgroup_id`. The syntax of **Visvg** is as follows:

```
C:          true_false = Visvg(vgroup_id, obj_ref);

FORTRAN:    true_false = vfisvg(vgroup_id, obj_ref)
```

Visvg returns either `TRUE` (or `1`) or `FALSE` (or `0`). The parameters of this routine are further defined in Table 5H on page 215.

5.6.2.6 Testing Whether an HDF Object within a Vgroup is a Vdata: Visvs

Visvs determines whether the data object specified by its reference number, `obj_ref`, is a vdata and is a member of the vgroup identified by the parameter `vgroup_id`. The syntax of **Visvs** is as follows:

```
C:          true_false = Visvs(vgroup_id, obj_ref);

FORTRAN:    true_false = vfisvs(vgroup_id, obj_ref)
```

Visvs returns either `TRUE` (or `1`) or `FALSE` (or `0`). The parameters of this routine are further defined in Table 5H.

TABLE 5H **Vinqtagref, Visvg, and Visvs Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vinqtagref [intn] **(vfinqtr)**	vgroup_id	int32	integer	Vgroup identifier
	obj_tag	int32	integer	Tag of the data object to be queried
	obj_ref	int32	integer	Reference number of the data object to be queried
Visvg [intn] **(vfisvg)**	vgroup_id	int32	integer	Vgroup identifier
	obj_ref	int32	integer	Data object reference number to be queried

Visvs [intn] **(vfisvs)**	vgroup_id	int32	integer	Vgroup identifier
	obj_ref	int32	integer	Data object reference number to be queried

5.6.2.7 Locating a Vdata in a Vgroup Given Vdata Fields: Vflocate

Vflocate locates a vdata that belongs to the vgroup identified by the parameter `vgroup_id` and contains the fields specified in the parameter `fieldname_list`. The syntax of **Vflocate** is as follows:

```
C:          vdata_ref = Vflocate(vgroup_id, fieldname_list);

FORTRAN:    vdata_ref = vffloc(vgroup_id, fieldname_list)
```

The parameter `fieldname_list` is a string of comma-separated field names containing no white space, for example, "`PX,PY,PZ`". Note that a vdata must contain all of the fields specified in `fieldname_list` to be qualified.

Vflocate returns the reference number of the vdata, if one is found, and `FAIL` (or `-1`) otherwise. The parameters of this routine are further defined in Table 5I.

5.6.2.8 Retrieving the Number of Tags of a Given Type in a Vgroup: Vnrefs

Vnrefs returns the number of tags of the type specified by the parameter `tag_type` in the vgroup identified by the parameter `vgroup_id`. The syntax of **Vnrefs** is as follows:

```
C:          num_of_tags = Vnrefs(vgroup_id, tag_type);

FORTRAN:    num_of_tags = vnrefs(vgroup_id, tag_type)
```

Possible values of the parameter `tag_type` are defined in Appendix A of this manual. **Vnrefs** returns 0 or the number of tags if successful, and `FAIL` (or `-1`) otherwise. The parameters of this routine are further defined in Table 5I.

TABLE 5I **Vflocate and Vnrefs Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
Vflocate [int32] **(vffloc)**	vgroup_id	int32	integer	Vgroup identifier
	fieldname_list	char *	character*(*)	Buffer containing the names of the fields
Vnrefs [int32] **(vnrefs)**	vgroup_id	int32	integer	Vgroup identifier
	tag_type	int32	integer	Tag type

5.6.2.9 Retrieving the Reference Number of a Vgroup: VQueryref

VQueryref returns the reference number of the vgroup identified by the parameter `vgroup_id`, or `FAIL` (or `-1`) if unsuccessful. The syntax of **VQueryref** is as follows:

```
C:          vgroup_ref = VQueryref(vgroup_id);

FORTRAN:    vgroup_ref = vqref(vgroup_id)
```

VQueryref is further defined in Table 5J.

5.6.2.10 Retrieving the Tag of a Vgroup: VQuerytag

VQuerytag returns `DFTAG_VG` (or `1965`), which would be the tag of the vgroup identified by the parameter `vgroup_id`, or `FAIL` (or `-1`) if unsuccessful. The syntax of **VQuerytag** is as follows:

```
C:          vgroup_tag = VQuerytag(vgroup_id);

FORTRAN:    vgroup_tag = vqtag(vgroup_id)
```

VQuerytag is further defined in Table 5J.

TABLE 5J **VQueryref and VQuerytag Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
VQueryref [int32] **(vqref)**	vgroup_id	int32	integer	Vgroup identifier
VQuerytag [int32] **(vqtag)**	vgroup_id	int32	integer	Vgroup identifier

EXAMPLE 5. **Operations on Vgroup Attributes**

This example illustrates the use of **Vfind/vfind** to locate a vgroup by its name, **Vsetattr/vfscatt** to attach an attribute to the vgroup, **Vattrinfo/vfainfo** to obtain information about the vgroup attribute, and **Vgetattr/vfgcatt** to obtain the attribute values.

The program obtains the version of the group then sets an attribute named "First Attribute" for the vgroup named "SD Vgroup". Next, the program gets the number of attributes that the vgroup has, and obtains and displays the name, the number of values, and the values of each attribute.

C:

```
#include "hdf.h"

#define  FILE_NAME      "General_Vgroups.hdf"
#define  VGROUP_NAME    "SD Vgroup"
#define  VGATTR_NAME    "First Attribute"
#define  N_ATT_VALUES   7              /* number of values in the attribute */

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

   intn   status_n,     /* returned status for functions returning an intn  */
          n_attrs;      /* number of attributes of the vgroup */
   int32  status_32,    /* returned status for functions returning an int32 */
          file_id, vgroup_ref, vgroup_id,
          attr_index, i, vg_version,
          data_type, n_values, size;
   char   vg_attr[N_ATT_VALUES] = {'v','g','r','o','u','p','\0'};
   char   vgattr_buf[N_ATT_VALUES], attr_name[30];

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

   /*
   * Open the HDF file for writing.
   */
   file_id = Hopen (FILE_NAME, DFACC_WRITE, 0);
```

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

/*
* Get the reference number of the vgroup named VGROUP_NAME.
*/
vgroup_ref = Vfind (file_id, VGROUP_NAME);

/*
* Attach to the vgroup found.
*/
vgroup_id = Vattach (file_id, vgroup_ref, "w");

/*
* Get and display the version of the attached vgroup.
*/
vg_version = Vgetversion (vgroup_id);
switch (vg_version) {
     case VSET_NEW_VERSION:
           printf ("\nVgroup %s is of the newest version, version 4\n",
                VGROUP_NAME);
        break;
     case VSET_VERSION:
           printf ("Vgroup %s is of a version between 3.2 and 4.0r2\n",
                VGROUP_NAME);
        break;
     case VSET_OLD_VERSION:
           printf ("Vgroup %s is of version before 3.2\n", VGROUP_NAME);
        break;
     default:
        printf ("Unknown version = %d\n", vg_version);
     } /* switch */

/*
* Add the attribute named VGATTR_NAME to the vgroup.
*/
status_n = Vsetattr (vgroup_id, VGATTR_NAME, DFNT_CHAR, N_ATT_VALUES,
                     vg_attr);

/*
* Get and display the number of attributes attached to this vgroup.
*/
n_attrs = Vnattrs (vgroup_id);
printf ("\nThis vgroup has %d attribute(s)\n", n_attrs);

/*
* Get and display the name and the number of values of each attribute.
* Note that the fourth and last parameters are set to NULL because the type
* and the size of the attribute are not desired.
*/
for (attr_index = 0; attr_index < n_attrs; attr_index++)
{
   status_n = Vattrinfo (vgroup_id, attr_index, attr_name, NULL,
                         &n_values, NULL);
   printf ("\nAttribute #%d is named %s and has %d values: ",
                         attr_index+1, attr_name, n_values);

   /*
   * Get and display the attribute values.
   */
```

```
         status_n = Vgetattr (vgroup_id, attr_index, vgattr_buf);
         for (i = 0; i < n_values; i++)
            printf ("%c ", vgattr_buf[i]);
         printf ("\n");
      }


      /*
      * Terminate access to the vgroup and to the V interface, and close
      * the HDF file.
      */
      status_32 = Vdetach (vgroup_id);
      status_n = Vend (file_id);
      status_n = Hclose (file_id);
   }
```

FORTRAN:

```
      program  vgroup_attribute
      implicit none
C
C     Parameter declaration
C
      character*19 FILE_NAME
      character*9  VGROUP_NAME
      character*15 VGATTR_NAME
C
      parameter (FILE_NAME    = 'General_Vgroups.hdf',
     +           VGROUP_NAME  = 'SD Vgroup',
     +           VGATTR_NAME  = 'First Attribute')
      integer VSET_NEW_VERSION, VSET_VERSION, VSET_OLD_VERSION
      parameter (VSET_NEW_VERSION = 4,
     +           VSET_VERSION     = 3,
     +           VSET_OLD_VERSION = 2)
      integer DFACC_WRITE
      parameter (DFACC_WRITE = 2)
      integer DFNT_CHAR
      parameter (DFNT_CHAR = 4)
      integer N_ATT_VALUES
      parameter (N_ATT_VALUES = 6)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfgver, vfscatt, vfnatts, vfainfo,
     +        vfind, vfgcatt, vfdtch, vfend
C
C**** Variable declaration *******************************************
C
      integer status, n_attrs
      integer file_id
      integer vgroup_id, vgroup_ref, vg_version
      integer attr_index, i
      integer data_type, n_values, size
      character vg_attr(N_ATT_VALUES)
      character vgattr_buf(N_ATT_VALUES), attr_name(30)
      data vg_attr /'v','g','r','o','u','p'/
C
C**** End of variable declaration ************************************
C
C
C     Open the HDF file for reading/writing.
```

```
C
      file_id = hopen(FILE_NAME, DFACC_WRITE, 0)
C
C     Initialize the V interface.
C
      status = vfstart(file_id)
C
C     Get the reference number of the vgroup named VGROUP_NAME.
C
      vgroup_ref = vfind(file_id, VGROUP_NAME)
C
C     Attach to the vgroup found.
C
      vgroup_id = vfatch(file_id, vgroup_ref , 'w')
C
C     Get and display the version of the attached vgroup.
C
      vg_version = vfgver(vgroup_id)
      if (vg_version .eq. VSET_NEW_VERSION) write(*,*)
     +   VGROUP_NAME, ' is of the newest version, version 4'
      if (vg_version .eq. VSET_VERSION) write(*,*)
     +   VGROUP_NAME, ' is of a version between 3.2 and 4.0r2'
      if(vg_version .eq. VSET_OLD_VERSION) write(*,*)
     +   VGROUP_NAME, ' is of version before 3.2'
      if ((vg_version .ne. VSET_NEW_VERSION) .and.
     +    (vg_version .ne. VSET_VERSION)     .and.
     +    (vg_version .ne. VSET_OLD_VERSION)) write(*,*)
     +    'Unknown version'
C
C     Add the attribute named VGATTR_NAME to the vgroup.
C
      status = vfscatt(vgroup_id, VGATTR_NAME, DFNT_CHAR, N_ATT_VALUES,
     +                 vg_attr)
C
C     Get and display the number of attributes attached to this group.
C
      n_attrs = vfnatts(vgroup_id)
      write(*,*) 'This group has', n_attrs, ' attributes'
C
C     Get and display the name and the number of values of each attribute.
C
      do 10 attr_index=1, n_attrs
         status = vfainfo(vgroup_id, attr_index-1, attr_name, data_type,
     +                    n_values, size)
      write(*,*) 'Attribute #', attr_index-1, ' is named ', attr_name
      write(*,*) 'and has', n_values, ' values: '
C
C     Get and display the attribute values.
C
      status = vfgcatt(vgroup_id, attr_index-1, vgattr_buf)
      write(*,*) (vgattr_buf(i), i=1,n_values)
10    continue
C
C     Terminate access to the vgroup.
C
      status = vfdtch(vgroup_id)
C
C     Terminate accessto the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

5.7 Deleting Vgroups and Data Objects within a Vgroup

The Vgroup interface includes two routines for deletion: one deletes a vgroup from a file and the other deletes a data object from a vgroup. These routines are discussed in the following subsections.

5.7.1 Deleting a Vgroup from a File: Vdelete

Vdelete removes the vgroup identified by the parameter `vgroup_id` from the file identified by the parameter `file_id`. The syntax of **Vdelete** is as follows:

```
C:         status = Vdelete(file_id, vgroup_id);

FORTRAN:   status = vdelete(file_id, vgroup_id)
```

This routine will remove the vgroup from the internal data structures and from the file.

Vdelete returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of **Vdelete** are further described in Table 5K on page 221.

5.7.2 Deleting a Data Object from a Vgroup: Vdeletetagref

Vdeletetagref deletes the data object, specified by the parameters `obj_tag` and `obj_ref`, from the vgroup, identified by the parameter `vgroup_id`. The syntax of **Vdeletetagref** is as follows:

```
C:         status = Vdeletetagref(vgroup_id, obj_tag, obj_ref);

FORTRAN:   status = vfdtr(vgroup_id, obj_tag, obj_ref)
```

Vinqtagref should be used to determine whether the tag/reference number pair exists before calling **Vdeletetagref**. If duplicate tag/reference number pairs are found in the vgroup, **Vdeletetagref** deletes the first occurrence. **Vinqtagref** should also be used to determine whether duplicate tag/reference number pairs exist in the vgroup.

Vdeletetagref returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further described in Table 5K.

TABLE 5K **Vdelete and Vdeletetagref Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vdelete [int32] **(vdelete)**	file_id	int32	integer	File identifier
	vgroup_id	int32	integer	Vgroup identifier
Vdeletetagref [int32] **(vfdtr)**	vgroup_id	int32	integer	Vgroup identifier
	obj_tag	int32	integer	Tag of the data object to be deleted
	obj_ref	int32	integer	Reference number of the data object to be deleted

5.8 Vgroup Attributes

HDF version 4.1r1 and later include the ability to assign attributes to a vgroup. The concept of attributes is fully explained in Chapter 3, *Scientific Data Sets (SD API)*. To review briefly, an attribute has a name, a data type, a number of attribute values, and the attribute values themselves. All attribute values must be of the same data type. For example, an attribute value cannot consist of ten characters and one integer, or a character value cannot be included in an attribute value consisting of two 32-bit integers.

Any number of attributes can be assigned to a vgroup, however, each attribute name must be unique among all attributes in the vgroup.

5.8.1 Obtaining the Vgroup Version Number of a Given Vgroup: Vgetversion

The structure of the vgroup has gone through several changes since HDF was first written. Determining the version of any particular vgroup is necessary as some of the older versions of vgroups do not support some of the newer features, such as attributes. **Vgetversion** returns the version number of the vgroup identified by the parameter `vgroup_id`. The syntax of **Vgetversion** is as follows:

```
C:          version_num = Vgetversion(vgroup_id);

FORTRAN:    version_num = vfgver(vgroup_id)
```

There are three valid version numbers: `VSET_OLD_VERSION` (or `2`), `VSET_VERSION` (or `3`), and `VSET_NEW_VERSION` (or `4`).

`VSET_OLD_VERSION` is returned when the vgroup is of a version that corresponds to an HDF library version before version 3.2.

`VSET_VERSION` is returned when the vgroup is of a version that corresponds to an HDF library version between versions 3.2 and 4.0 release 2.

`VSET_NEW_VERSION` is returned when the vgroup is of a version that corresponds to an HDF library version of version 4.1 release 1 or higher.

Vgetversion returns the vgroup version number if successful, and `FAIL` (or `-1`) otherwise. This routine is further defined in Table 5L on page 223.

5.8.2 Obtaining Information on a Given Vgroup Attribute: Vattrinfo

Vattrinfo retrieves the name, data type, number of values, and the size of the values of an attribute that belongs to the vgroup identified by the parameter `vgroup_id`. The syntax of **Vattrinfo** is as follows:

```
C:          status = Vattrinfo(vgroup_id, attr_index, attr_name,
                           &data_type, &n_values, &size);

FORTRAN:    status = vfainfo(vgroup_id, attr_index, attr_name, data_type,
                           n_values, size)
```

Vattrinfo stores the name, data type, number of values, and the size of the value of the attribute into the parameters `attr_name`, `data_type`, `n_values`, and `size`, respectively.

The attribute is specified by its index, `attr_index`. The valid values of `attr_index` range from 0 to the total number of attributes attached to the vgroup - 1. The number of vgroup attributes can be obtained using the routine **Vnattrs**.

The parameter `data_type` is an integer number. Refer to Table 2E on page 14 for the definitions of the data types to interpret this value. The parameter `size` contains the number of bytes taken by an attribute value.

In C, the parameters `attr_name`, `data_type`, `n_values`, and `size` can be set to `NULL`, if the information returned by these parameters is not needed.

Vattrinfo returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further described in Table 5L.

5.8.3 Obtaining the Total Number of Vgroup Attributes: Vnattrs

Vnattrs returns the number of attributes assigned to the vgroup specified by the parameter `vgroup_id`. The syntax of **Vnattrs** is as follows:

```
C:          num_of_attrs = Vnattrs(vgroup_id);

FORTRAN:    num_of_attrs = vfnatts(vgroup_id)
```

Vnattrs returns either the number of attributes or `FAIL` (or `-1`). This routine is further defined in Table 5L.

TABLE 5L **Vgetversion, Vattrinfo, and Vnattrs Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vgetversion [int32] **(vfgver)**	vgroup_id	int32	integer	Vgroup identifier
Vattrinfo [intn] **(vfainfo)**	vgroup_id	int32	integer	Vgroup identifier
	attr_index	intn	integer	Index of the attribute
	attr_name	char *	character*(*)	Returned name of the attribute
	data_type	int32 *	integer	Returned data type of the attribute
	n_values	int32 *	integer	Returned number of values of the attribute
	size	int32 *	integer	Returned size, in bytes, of the value of the attribute
Vnattrs [intn] **(vfnatts)**	vgroup_id	int32	integer	Vgroup identifier

5.8.4 Setting the Attribute of a Vgroup: Vsetattr

Vsetattr attaches an attribute to the vgroup specified by the parameter `vgroup_id`. The syntax of **Vsetattr** is as follows:

```
C:          status = Vsetattr(vgroup_id, attr_name, data_type, n_values,
                              attr_values);

FORTRAN:    status = vfsnatt(vgroup_id, attr_name, data_type, n_values,
                              attr_values)

     OR     status = vfscatt(vgroup_id, attr_name, data_type, n_values,
                              attr_values)
```

If the attribute with the name specified in the parameter `attr_name` already exists, the new values will replace the current ones, provided the data type and count are not different. If either the data type or the count have been changed, **Vsetattr** will return `FAIL` (or `-1`).

The parameter `data_type` is an integer number specifying the data type of the attribute values. Refer to Table 2E on page 14 for the definition of the data types to interpret this value. The parameter `n_values` specifies the number of values to be stored in the attribute. The buffer `attr_values` contains the values to be stored in the attribute.

Note that the FORTRAN-77 version of **Vsetattr** has two routines; **vfsnatt** sets a numeric value attribute and **vfscatt** sets a character value attribute.

Vsetattr returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5M on page 224.

5.8.5 Retrieving the Values of a Given Vgroup Attribute: Vgetattr

Vgetattr retrieves the values of an attribute of the vgroup specified by the parameter `vgroup_id`. The syntax of **Vgetattr** is as follows:

```
C:          status = Vgetattr(vgroup_id, attr_index, attr_values);

FORTRAN:    status = vfgnatt(vgroup_id, attr_index, attr_values)
    OR      status = vfgcatt(vgroup_id, attr_index, attr_values)
```

The attribute is specified by its index, `attr_index`. The valid values of `attr_index` range from 0 to the total number of attributes attached to the vgroup - 1. The number of vgroup attributes can be obtained using the routine **Vnattrs**.

The buffer `attr_values` must be sufficiently allocated to hold the retrieved attribute values. Use **Vattrinfo** to obtain information about the attribute values for appropriate memory allocation.

This routine is often used with **Vinquire** in a loop to retrieve the total number of attributes.

Note that the FORTRAN-77 version of **Vgetattr** has two routines; **vfgnatt** gets a numeric value attribute and **vfgcatt** gets a character value attribute.

Vgetattr returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5M on page 224.

5.8.6 Retrieving the Index of a Vgroup Attribute Given the Attribute Name: Vfindattr

Vfindattr searches the vgroup, identified by the parameter `vgroup_id`, for the attribute with the name specified by the parameter `attr_name`, and returns the index of that attribute. The syntax of this routine is as follows:

```
C:          attr_index = Vfindattr(vgroup_id, attr_name);

FORTRAN:    attr_index = vffdatt(vgroup_id, attr_name)
```

Vfindattr returns either an attribute index or `FAIL` (or `-1`). The parameters of this routine are further defined in Table 5M.

TABLE 5M **Vsetattr, Vgetattr, and Vfindattr Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
Vsetattr [intn] **(vfsnatt/vfscatt)**	vgroup_id	int32	integer	Vgroup identifier
	attr_name	char *	character*(*)	Name of the attribute
	data_type	int32	integer	Data type of the attribute
	n_values	int32	integer	Number of values the attribute contains
	attr_values	VOIDP	<valid numeric data type>(*)/ character* (*)	Buffer containing the attribute values

Vgetattr [intn] **(vfgnatt/vfgcatt)**	vgroup_id	int32	integer	Vgroup identifier
	attr_index	intn	integer	Index of the attribute
	attr_values	VOIDP	<valid numeric data type> (*)/ character*(*)	Buffer containing attribute values
Vfindattr [intn] **(vffdatt)**	vgroup_id	int32	integer	Vgroup identifier
	attr_name	char *	character*(*)	Name of the target attribute

EXAMPLE 6.

Obtaining Information about the Contents of a Vgroup

This example illustrates the use of **Vgetid/vfgid** to get the reference number of a vgroup, **Vntagrefs/vfntr** to get the number of HDF data objects in the vgroup, **Vgettagref/vfgttr** to get the tag/reference number pair of a data object within the vgroup, and **Visvg/vfisvg** and **Visvs/ vfisvs** to determine whether a data object is a vgroup and a vdata, respectively.

In the example, the program traverses the HDF file "General_Vgroups.hdf" from the beginning and obtains the reference number of each vgroup so it can be attached. Once a vgroup is attached, the program gets the total number of tag/reference number pairs in the vgroup and displays some information about the vgroup. The information displayed includes the position of the vgroup in the file, the tag/reference number pair of each of its data objects, and the message stating whether the object is a vdata, vgroup, or neither.

C:

```
#include "hdf.h"

#define   FILE_NAME        "General_Vgroups.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, vgroup_id, vgroup_ref,
          obj_index,    /* index of an object within a vgroup */
          num_of_pairs, /* number of tag/ref number pairs, i.e., objects */
          obj_tag, obj_ref,     /* tag/ref number of an HDF object */
          vgroup_pos = 0;       /* position of a vgroup in the file */

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

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

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

   /*
   * Obtain each vgroup in the file by its reference number, get the
   * number of objects in the vgroup, and display the information about
   * that vgroup.
   */
   vgroup_ref = -1;        /* set to -1 to search from the beginning of file */
   while (TRUE)
```

```
{
   /*
   * Get the reference number of the next vgroup in the file.
   */
   vgroup_ref = Vgetid (file_id, vgroup_ref);

   /*
   * Attach to the vgroup for reading or exit the loop if no more vgroups
   * are found.
   */
   if (vgroup_ref == -1) break;
   vgroup_id = Vattach (file_id, vgroup_ref, "r");

   /*
   * Get the total number of objects in the vgroup.
   */
   num_of_pairs = Vntagrefs (vgroup_id);

   /*
   * If the vgroup contains any object, print the tag/ref number
   * pair of each object in the vgroup, in the order they appear in the
   * file, and indicate whether the object is a vdata, vgroup, or neither.
   */
   if (num_of_pairs > 0)
   {
      printf ("\nVgroup #%d contains:\n", vgroup_pos);
      for (obj_index = 0; obj_index < num_of_pairs; obj_index++)
      {
         /*
         * Get the tag/ref number pair of the object specified
         * by its index, obj_index, and display them.
         */
         status_n = Vgettagref (vgroup_id, obj_index, &obj_tag, &obj_ref);
         printf ("tag = %d, ref = %d", obj_tag, obj_ref);

         /*
         * State whether the HDF object referred to by obj_ref is a vdata,
         * a vgroup, or neither.
         */
         if (Visvg (vgroup_id, obj_ref))
            printf ("  <-- is a vgroup\n");
         else if (Visvs (vgroup_id, obj_ref))
            printf ("  <-- is a vdata\n");
         else
            printf ("  <-- neither vdata nor vgroup\n");
      } /* for */
   } /* if */

   else
      printf ("Vgroup #%d contains no HDF objects\n", vgroup_pos);

   /*
   * Terminate access to the current vgroup.
   */
   status_32 = Vdetach (vgroup_id);

   /*
   * Move to the next vgroup position.
   */
   vgroup_pos++;
} /* while */

/*
```

```
   * Terminate access to the V interface and close the file.
   */
   status_n = Vend (file_id);
   status_n = Hclose (file_id);
}
```

FORTRAN:

```
      program  vgroup_contents
      implicit none
C
C     Parameter declaration
C
      character*19 FILE_NAME
C
      parameter (FILE_NAME = 'General_Vgroups.hdf')
      integer DFACC_ READ
      parameter (DFACC_READ = 1)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vfatch, vfgid, vntrc, vfgttr, vfisvg,
     +        vfisvs, vfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id
      integer vgroup_id, vgroup_ref,  vgroup_pos
      integer obj_index, num_of_pairs
      integer obj_tag, obj_ref
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 V interface.
C
      status = vfstart(file_id)
C
C     Obtain each vgroup in the file by its reference number, get the
C     number of objects in the vgroup, and display the information
C     about that vgroup.
C
      vgroup_ref = -1
      vgroup_pos = 0
10    continue
C
C     Get the reference number of the next vgroup in the file.
C
      vgroup_ref = vfgid(file_id, vgroup_ref)
C
C     Attach to the vgroup or go to the end if no additional vgroup is found.
C
      if(vgroup_ref. eq. -1) goto 100
      vgroup_id = vfatch(file_id, vgroup_ref , 'r')
C
C     Get the total number of objects in the vgroup.
```

```
C
      num_of_pairs = vntrc(vgroup_id)
C
C     If the vgroup contains any object, print the tag/ref number
C     pair of each object in vgroup, in the order they appear in the
C     file, and indicate whether the object is a vdata, vgroup, or neither.
C
      if (num_of_pairs .gt. 0) then
         write(*,*) 'Vgroup # ', vgroup_pos, ' contains:'
         do 20 obj_index = 1, num_of_pairs
C
C     Get the tag/ref number pair of the object specified by its index
C     and display them.
C
         status = vfgttr(vgroup_id, obj_index-1, obj_tag, obj_ref)
C
C     State whether the HDF object referred to by obj_ref is a vdata,
C     a vgroup, or neither.
C
         if( vfisvg(vgroup_id, obj_ref) .eq. 1) then
             write(*,*) 'tag = ', obj_tag, ' ref = ', obj_ref,
     +       '  <--- is a vgroup '
         else if ( vfisvs(vgroup_id, obj_ref) .eq. 1) then
             write(*,*) 'tag = ', obj_tag, ' ref = ', obj_ref,
     +       '  <--- is a vdata '
         else
             write(*,*) 'tag = ', obj_tag, ' ref = ', obj_ref,
     +       '  <--- neither vdata nor vgroup '
         endif
20       continue
      else
         write (*,*) 'Vgroup #', vgroup_pos, ' contains no HDF objects'
      endif
      write(*,*)
      vgroup_pos = vgroup_pos + 1
      goto 10
100   continue
C
C     Terminate access to the vgroup.
C
      status = vfdtch(vgroup_id)
C
C     Terminate access to the V interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

5.9 Obsolete Vgroup Interface Routines

The following routines have been replaced by newer routines with similar functionality. These routines are still supported by the Vgroup interface, but their use is not recommended. HDF may not support these routines in a future version.

5.9.1 Determining the Next Vgroup or Vdata Identifier: Vgetnext

Vgetnext gets the reference number of the next member of a vgroup. This member can be either a vgroup or vdata. The syntax for **Vgetnext** is as follows:

```
C:          ref_num = Vgetnext(vgroup_id, v_ref);
```

```
FORTRAN:   ref_num = vfgnxt(vgroup_id, v_ref)
```

Vgetnext searches the vgroup, identified by the parameter `vgroup_id`, for the vgroup or vdata whose reference number is specified by the parameter `v_ref`. If this vgroup or vdata is found, **Vgetnext** finds the next vgroup or vdata and returns its reference number. If `v_ref` is set to `-1`, the routine will return the reference number of the first vgroup or vdata in the vgroup.

Vgetnext is now obsolete as the routine **Vgettagref** provides the same functionality. In addition, **Vgettagref** is not restricted to searching for members that are vgroups or vdatas.

Vgetnext returns a reference number if the next vgroup or vdata is found, or `FAIL` (or `-1`) when an error occurs or when there are no more vdatas or vgroups in the vgroup. The parameters of **Vgetnext** are further defined in Table 5N.

5.9.2 Determining the Number of Members and Vgroup Name: Vinquire

Vinquire retrieves the number of data objects and the name of the vgroup identified by the parameter `vgroup_id`. The syntax for **Vinquire** is as follows:

```
C:         status = Vinquire(vgroup_id, &n_members, vgroup_name);

FORTRAN:   status = vfinq(vgroup_id, n_members, vgroup_name)
```

Vinquire stores the number of data objects and the vgroup name in the parameters `n_members` and `vgroup_name`, respectively. In C, if either `n_members` or `vgroup_name` is set to `NULL`, the corresponding data is not returned. The maximum length of the vgroup's name is defined by `VGNAMELENMAX` (or `64`).

Vinquire is now obsolete as the **Vntagrefs** routine can be used to get the number of data objects in a vgroup and **Vgetname** can be used to retrieve the name of a vgroup.

Vinquire returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters of this routines are further defined in Table 5N.

TABLE 5N **Vgetnext and Vinquire Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
Vgetnext [int32] **(vfgnxt)**	vgroup_id	int32	integer	Vgroup identifier of the parent vgroup
	v_ref	int32	integer	Reference number for the target vgroup
Vinquire [intn] **(vfinq)**	vgroup_id	int32	integer	Vgroup identifier
	n_members	int32 *	integer	Pointer to the number of entries in the vgroup
	vgroup_name	char *	character*(*)	Buffer for the name of the vgroup

5.10 Vgroup Backward Compatibility Issues

5.10.1 Vset Implementation Integrated into the Vgroup Interface

In HDF versions before 2.0, vsets were created and manipulated through an interface separate from the other HDF interfaces. A pointer to a specially-defined vset structure was returned by the Vset interface and data type definitions specific to the Vset interface were used. The names of these definitions were prefaced by "LOCAL_".

After HDF version 2.0, the `vgroup_id` identifier replaced the pointer to the vset structure, the "LOCAL_" data type definitions were made obsolete by newer definitions, and all vset functionality was integrated into the Vgroup interface routines. HDF programs written for HDF libraries earlier than version 2.0 should be modified accordingly in order to function correctly with newer versions of HDF.