Chapter 4

Vdatas (VS API)

4.1 Chapter Overview

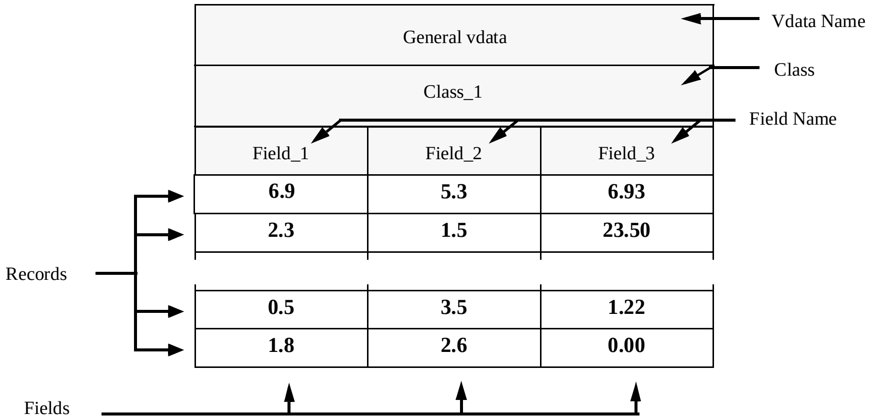
This chapter describes the vdata data model, the Vdata interface (also called the VS interface or the VS API), and the vdata programming model.

4.2 The Vdata Model

The HDF ***Vdata model*** provides a framework for storing customized tables, or ***vdatas***, in HDF files. The term “vdata” is an abbreviation of “vertex data”, alluding to the fact that the object was first implemented in HDF to store the vertex and edge information of polygon sets. The vdata design has since been generalized to apply to a broader variety of applications.

A vdata is like a table that consists of a collection of ***records*** whose values are stored in fixed-length ***fields***. All records have the same structure and all values in each field have the same data type. Vdatas are uniquely identified by a ***name***, a ***class***, and a series of individual ***field names***. (See Figure 4a.)

FIGURE 4a **Vdata Table Structure**



Field_1	Field_2	Field_3
6.9	**5.3**	**6.93**
2.3	**1.5**	**23.50**
0.5	**3.5**	**1.22**
1.8	**2.6**	**0.00**

A ***vdata name*** is a label typically assigned to describe the contents of a vdata. It often serves as a search key to locate a vdata in a file. A ***vdata class*** further distinguishes a particular vdata by identifying the purpose or the use of its data. Finally, ***vdata field names*** are labels assigned to the fields in the vdata.

4.2.1 Records and Fields

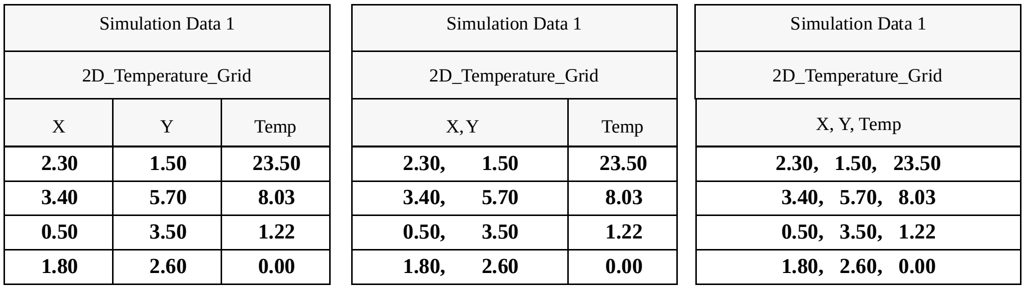
Each ***record*** in a vdata is composed of one or more fixed-length ***fields***. Vdata records and fields are identified by an index. The record and field indexes are zero-based and are separately incremented by one for each additional record and field in the vdata.

Every field in a vdata is assigned a data type when the vdata is created. The data type of a field may be any basic HDF data type: character, 8-bit, 16-bit, and 32-bit signed and unsigned integers, and 32-bit and 64-bit floating point numbers. The maximum length of a vdata record is 32,767 bytes.

The Vdata model allows multiple entries per field as long as they have the same data type. The number of entries or ***components*** in a field is called the ***order*** of the field.

The organizational structure of a vdata is often determined by the data types of its data set or sets. For example, given a data set describing the location (“X,Y”) and temperature (“Temp”) of points in a plane, there are several ways to organize the data. (See Figure 4b.) If the “X”, “Y” and “Temp” values are of the same data type, they could be stored as three single-component fields, as a two-component “X,Y” field and a single-component “Temp” field, or as a three-component “X,Y,Temp” field. Generally the “X,Y” data is stored in a single field, but HDF places no restrictions on the organization of field data and there are no significant HDF performance issues involved in choosing one organizational regime over another.

FIGURE 4b **Three Different Vdata Structures for Data of the Same Number Type**



Simulation Data 1		
2D_Temperature_Grid		
X	Y	Temp
2.30	**1.50**	**23.50**
3.40	**5.70**	**8.03**
0.50	**3.50**	**1.22**
1.80	**2.60**	**0.00**

3 Single-component Fields

Simulation Data 1	
2D_Temperature_Grid	
X,Y	Temp
2.30, 1.50	**23.50**
3.40, 5.70	**8.03**
0.50, 3.50	**1.22**
1.80, 2.60	**0.00**

1 Multi-component Field of Order 2
1 Single-component Field

Simulation Data 1
2D_Temperature_Grid
X, Y, Temp
2.30, 1.50, 23.50
3.40, 5.70, 8.03
0.50, 3.50, 1.22
1.80, 2.60, 0.00

1 Multi-component Field of Order 3

4.3 The Vdata Interface

The Vdata interface consists of routines that are used to store and retrieve information about vdatas and their contents.

4.3.1 Header Files Used by the Vdata Interface

The header file “hdf.h” must be included in programs that invoke Vdata interface routines.

4.3.2 Vdata Library Routines

Vdata routines begin with the prefixes “VS”, “VF”, “VSQ”, and “VH” in C, and “vsf”, “vf”, “vsq”, and “vh” in FORTRAN-77. Vdata routines perform most general vdata operations, VF routines query information about vdata fields, and VSQ routines query information about specific vdatas. VH routines are high-level procedures that write to single-field vdatas.

Vdata routines let you define, organize and manipulate vdatas. They are categorized as follows and are listed in Table 4A by their categories:

- ***Access routines*** control access to files and vdatas. Data transfer to and from a vdata can only occur after the access to the vdata has been initiated and before it is terminated. Some Vgroup interface routines are included since they are used interchangeably between the Vdata and Vgroup interfaces. Refer to Chapter 5, *Vgroups (V API)*, for a description of the Vgroup interface.
- ***Read and write routines*** store and retrieve the contents of and the information about a vdata.
- ***File inquiry routines*** provide information about how vdatas are stored in a file. They are useful for locating vdatas in the file.
- ***Vdata inquiry routines*** provide specific information about a given vdata, including the vdata's name, class, number of records, tag and reference number pairs, size, and interlace mode.
- ***Field inquiry routines*** provide specific information about the fields in a given vdata, including the field's size, name, order, and type, and the number of fields in the vdata.

TABLE 4A

Vdata Interface Routines

Category	Routine Names		Description
	C	FORTRAN-77	
Access/Create	`Vstart`	`vfstart`	Initializes the Vdata and the Vgroup interfaces (Section 4.3.5 on page 130)
	`VSattach`	`vsfatch`	Establishes access to a specified vdata (Section 4.3.5 on page 130)
	`VSdetach`	`vsfdtch`	Terminates access to a specified vdata (Section 4.3.6 on page 130)
	`Vend`	`vfend`	Terminates access to the Vdata and the Vgroup interfaces (Section 4.3.6 on page 130)
Read and Write	`VSfdefine`	`vsffdef`	Defines a new vdata field (Section 4.5.1.2 on page 141)
	`VSread`	`vsfrd/vsfrdc/vsfread`	Reads one record from a vdata (Section 4.6.2 on page 157)
	`VSseek`	`vsfseek`	Seeks to a specified record in a vdata (Section 4.5.2.1 on page 144)
	`VSsetattr`	`vsfsnat/vsfscat`	Sets the attribute of a vdata field or vdata (Section 4.8.2 on page 170)
	`VSsetclass`	`vsfscls`	Assigns a class to a vdata (Section 4.5.1.1 on page 141)
	`VSsetfields`	`vsfsfld`	Specifies the vdata fields to be read or written (Section 4.5.1.3 on page 142 and Section 4.6.1 on page 157)
	`VSsetinterlace`	`vsfsint`	Sets the interlace mode for a vdata (Section 4.5.1.4 on page 142)
	`VSsetname`	`vsfsnam`	Assigns a name to a vdata (Section 4.5.1.1 on page 141)
	`VHstoredata`	`vhfsd/vhfscd`	Writes data to a vdata with a single-component field (Section 4.4 on page 135)
	`VHstoredatam`	`vhfsdm/vhfscdm`	Writes data to a vdata with a multi-component field (Section 4.4 on page 135)
	`VSwrite`	`vsfwrt/vsfwrtc/vsfwrit`	Writes records to a vdata (Section 4.5.2.2 on page 145)

Vdata Inquiry	VSattrinfo	vsfainf	Retrieves information on a given attribute (Section 4.8.7 on page 173)
	VSelts	vsfelts	Returns the number of records in the specified vdata (Section 4.9.3 on page 184)
	VSfexist	vsfex	Locates a vdata given a list of field names (Section 4.7.4 on page 166)
	VSfindex	vsffidx	Returns the index of a vdata field given the field name (Section 4.8.1 on page 170)
	VSfnattrs	vsffnas	Returns the number of attributes of a vdata or vdata field (Section 4.8.5 on page 172)
	VSfindattr	vsffdat	Retrieves the index of an attribute given the attribute name (Section 4.8.6 on page 173)
	VSgetattr	vsfgnat/vsfgcat	Retrieves the values of a given attribute (Section 4.8.3 on page 171)
	VSgetclass	vsfgcls	Returns the class name of the specified vdata (Section 4.9.3 on page 184)
	VSgetfields	vsfgfld	Retrieves all field names within the specified vdata (Section 4.9.3 on page 184)
	VSgetinterlace	vsfgint	Retrieves the interlace mode of the specified vdata (Section 4.9.3 on page 184)
	VSgetname	vsfgnam	Retrieves the name of the specified vdata (Section 4.9.3 on page 184)
	VSinquire	vsfinq	Returns information about the specified vdata (Section 4.9.1 on page 179)
	VSisattr	vsfisat	Determines whether the given vdata is an attribute (Section 4.8.8 on page 174)
	VSnattrs	vsfnats	Returns the total number of vdata attributes (Section 4.8.4 on page 172)
	VSQuerycount	vsqfnelt	Returns the number of records in the specified vdata (Section 4.9.2 on page 182)
	VSQueryfields	vsqfflds	Returns the field names of the specified vdata (Section 4.9.2 on page 182)
	VSQueryinterlace	vsqfintr	Returns the interlace mode of the specified vdata (Section 4.9.2 on page 182)
	VSQueryname	vsqfname	Returns the name of the specified vdata (Section 4.9.2 on page 182)
	VSQueryref	vsqref	Retrieves the reference number of the specified vdata (Section 4.9.2 on page 182)
	VSQuerytag	vsqtag	Retrieves the tag of the specified vdata (Section 4.9.2 on page 182)
	VSQueryvsize	vsqfsiz	Retrieves the local size in bytes of the specified vdata record (Section 4.9.2 on page 182)
	VSsetattr	vsfsnat/vsfscat	Sets the attribute of a vdata field or vdata (Section 4.8.2 on page 170)
	VSsizeof	vsfsiz	Returns the size of the specified fields in a vdata (Section 4.9.3 on page 184)

Field Inquiry	`VFfieldesize`	`vffesiz`	Returns the field size, as stored in a file, of a specified field (Section 4.9.4 on page 185)
	`VFfieldisize`	`vffisiz`	Returns the field size, as stored in memory, of a specified field (Section 4.9.4 on page 185)
	`VFfieldname`	`vffname`	Returns the name of the specified field in the given vdata (Section 4.9.4 on page 185)
	`VFfieldorder`	`vffordr`	Returns the order of the specified field in the given vdata (Section 4.9.4 on page 185)
	`VFfieldtype`	`vfftype`	Returns the data type for the specified field in the given vdata (Section 4.9.4 on page 185)
	`VFnfields`	`vfnflds`	Returns the total number of fields in the specified vdata (Section 4.9.4 on page 185)
File Inquiry	`VSfind`	`vsffnd`	Searches for a vdata in a file given the vdata's name (Section 4.7.3 on page 166)
	`VSgetid`	`vsfgid`	Returns the reference number of the next vdata in the file (Section 4.7.2 on page 165)
	`VSlone`	`vsflone`	Returns the reference number of vdatas that are not linked with any vgroups (Section 4.7.1 on page 165)

4.3.3 Identifying Vdatas in the Vdata Interface

The Vdata interface identifies vdatas in several ways. Before an existing vdata is accessible, it is uniquely identified by its ***reference number***. The reference number of a vdata can be obtained from the name or the class of the vdata, or by sequentially traversing the file. The concept of reference number is discussed in Section 2.2.2.1 on page 8.

When a vdata is attached, it is assigned with an identifier, called ***vdata id***, which is used by the Vdata interface routines in accessing the vdata.

4.3.4 Programming Model for the Vdata Interface

The programming model for accessing vdatas is as follows:

1. Open the file.
2. Initialize the Vdata interface.
3. Create a new vdata or open an existing one using its reference number.
4. Perform the desired operations on the vdata.
5. Terminate access to the vdata.
6. Terminate access to the Vdata interface.
7. Close the file.

To access a vdata, the calling program must contain the following calls, which are individually explained in the following subsections:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            status = Vstart(file_id);
            vdata_id = VSattach(file_id, vdata_ref, vdata_access_mode);
            <Optional operations>
            status = VSdetach(vdata_id);
            status = Vend(file_id);
            status = Hclose(file_id);

FORTRAN:    file_id = hopen(filename, file_access_mode, num_dds_block)
            status = vfstart(file_id)
            vdata_id = vsfatch(file_id, vdata_ref, vdata_access_mode)
```

```
<Optional operations>
status = vsfdtch(vdata_id)
status = vfend(file_id)
status = hclose(file_id)
```

4.3.5 Accessing Files and Vdatas: Vstart and VSattach

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

Vstart must be called for every file to be accessed. This routine initializes the internal vdata structures used by the Vdata interface. **Vstart** has only one argument, the file identifier (`file_id`) 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.

VSattach initiates access to a vdata and must be called before any operations on the vdata may occur. **VSattach** takes three arguments: `file_id`, `vdata_ref`, and `vdata_access_mode`, and returns either a vdata identifier or `FAIL` (or `-1`).

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

If an existing vdata's reference number is unknown, it must be obtained prior to the **VSattach** call. (Refer to Chapter 2, *HDF Fundamentals*, for a description of reference numbers.) The HDF library provides two routines for this purpose, **VSfind** and **VSgetid**. **VSfind** can be used to obtain the reference number of a vdata when the vdata's name is known. **VSgetid** can be used to obtain the reference number when only the location of the vdata within the file is known; this is often discovered by sequentially traversing the file. These routines are discussed in Section 4.7.2 on page 165 and Section 4.7.3 on page 166.

The argument `vdata_access_mode` specifies the access mode ("`r`" for read-only access or "`w`" for read and write access) for subsequent operations on the specified vdata. Although several HDF user programs may simultaneously read from one vdata, only one write access is allowed at a time. The "`r`" access mode may only be used with existing vdatas; the "`w`" access mode is valid with both new vdatas (`vdata_ref = -1`) *and* existing vdatas.

Note that, although a vdata can be created without being written with data, either the routine **VSsetname** or **VSsetfields** must be called in order for the vdata to exist in the file.

The parameters for **Vstart** and **VSattach** are further defined in Table 4B on page 131.

4.3.6 Terminating Access to Vdatas and Files: VSdetach and Vend

VSdetach terminates access to a vdata by updating pertinent information and freeing all memory associated with the vdata and initialized by **VSattach**. Once access to the vdata is terminated, its identifier becomes invalid and any attempt to access it will result in an error condition. **VSdetach** takes only one argument, the vdata identifier that is returned by **VSattach**, and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`).

Vend releases all internal data structures allocated by **Vstart**. **Vend** must be called once for each call to **Vstart** and only after access to all vdatas have been terminated (i.e., all calls to **VSdetach** have been made). Attempts to call Vdata interface routines after calling **Vend** will result in an error condition. **Vend** takes one argument, the file identifier that is returned by **Hopen**, and returns either SUCCEED (or 0) or FAIL (or -1). Note that the **Vend** routine is used by both the Vdata and Vgroup interfaces.

In summary, successfully terminating access to a vdata requires one **VSdetach** call for each call to **VSattach** and one **Vend** call for each call to **Vstart**.

The parameters for **VSdetach** and **Vend** are further defined in Table 4B.

Hclose terminates access to a file and should only be called after all **Vend** calls have been made to close the Vdata interface. Refer to Chapter 2, *HDF Fundamentals*, for a description of **Hclose**.

TABLE 4B

Vstart, VSattach, VSdetach, 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
VSattach [int32] **(vsfatch)**	file_id	int32	integer	File identifier
	vdata_ref	int32	integer	Reference number of the vdata
	vdata_access_mode	char *	character*1	Vdata access mode
VSdetach [int32] **(vsfdtch)**	vdata_id	int32	integer	Vdata identifier
Vend [intn] **(vfend)**	file_id	int32	integer	File identifier

EXAMPLE 1.

Accessing a Vdata in an HDF File

This example illustrates the use of **Hopen/hopen**, **Vstart/vfstart**, **VSattach/vsfatch**, **VSdetach/vsfdtch**, **Vend/vfend**, and **Hclose/hclose** to create and to access different vdatas from different HDF files.

The program creates an HDF file, named "General_Vdatas.hdf", containing a vdata. The program also creates a second HDF file, named "Two_Vdatas.hdf", containing two vdatas. Note that, in this example, the program does not write data to these vdatas. Also note that before closing the file, the access to its vdatas and its corresponding Vdata interface must be terminated. These examples request information about a specific vdata.

C:

```
#include "hdf.h"

#define  FILE1_NAME     "General_Vdatas.hdf"
#define  FILE2_NAME     "Two_Vdatas.hdf"
#define  VDATA_NAME     "Vdata 1"
#define  VDATA_CLASS    "Empty Vdatas"

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

   intn  status_n;      /* returned status for functions returning an intn  */
   int32 status_32,     /* returned status for functions returning an int32 */
         file1_id, file2_id,
         vdata_id, vdata1_id, vdata2_id,
         vdata_ref = -1;     /* ref number of a vdata, set to -1 to create  */
```

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

/*
* Create the first HDF file.
*/
file1_id = Hopen (FILE1_NAME, DFACC_CREATE, 0);

/*
* Initialize the VS interface associated with the first HDF file.
*/
status_n = Vstart (file1_id);

/*
* Create a vdata in the first HDF file.
*/
vdata_id = VSattach (file1_id, vdata_ref, "w");

/*
* Assign a name to the vdata.
*/
status_32 = VSsetname (vdata_id, VDATA_NAME);

/*
* Other operations on the vdata identified by vdata_id can be carried
* out starting from this point.
*/

/*
* Create the second HDF file.
*/
file2_id = Hopen (FILE2_NAME, DFACC_CREATE, 0);

/*
* Initialize the VS interface associated with the second HDF file.
*/
status_n = Vstart (file2_id);

/*
* Create the first vdata in the second HDF file.
*/
vdata1_id = VSattach (file2_id, vdata_ref, "w");

/*
* Create the second vdata in the second HDF file.
*/
vdata2_id = VSattach (file2_id, vdata_ref, "w");

/*
* Assign a class name to these vdatas.
*/
status_32 = VSsetclass (vdata1_id, VDATA_CLASS);
status_32 = VSsetclass (vdata2_id, VDATA_CLASS);

/*
* Other operations on the vdatas identified by vdata1_id and vdata2_id
* can be carried out starting from this point.
*/

/*
* Terminate access to the first vdata in the second HDF file.
*/
status_32 = VSdetach (vdata1_id);
```

```
   /*
   * Terminate access to the second vdata in the second HDF file.
   */
   status_32 = VSdetach (vdata2_id);

   /*
   * From this point on, any operations on the vdatas identified by vdata1_id
   and vdata2_id are invalid but not on the vdata identified by vdata_id.
   */

   /*
   * Terminate access to the VS interface associated with the second HDF file.
   */
   status_n = Vend (file2_id);

   /*
   * Close the second HDF file.
   */
   status_n = Hclose (file2_id);

   /*
   * Terminate access to the vdata in the first HDF file.
   */
   status_32 = VSdetach (vdata_id);

   /*
   * Terminate access to the VS interface associated with the first HDF file.
   */
   status_n = Vend (file1_id);

   /*
   * Close the first HDF file.
   */
   status_n = Hclose (file1_id);
}
```

FORTRAN:

```
      program create_vdatas
      implicit none
C
C     Parameter declaration
C
      character*18 FILE1_NAME
      character*14 FILE2_NAME
      character*7  VDATA_NAME
      character*12 VDATA_CLASS
C
      parameter (FILE1_NAME  = ’General_Vdatas.hdf’,
     +           FILE2_NAME  = ’Two_Vdatas.hdf’,
     +           VDATA_NAME  = ’Vdata 1’,
     +           VDATA_CLASS = ’Empty Vdatas’)
      integer DFACC_CREATE
      parameter (DFACC_CREATE = 4)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsfsnam, vsfscls, vsfdtch, vfend

C
C**** Variable declaration *******************************************
```

```
C
      integer status
      integer file1_id, file2_id
      integer vdata_id, vdata1_id, vdata2_id
      integer vdata_ref
C
C**** End of variable declaration ************************************
C
C
C     Create the first HDF file.
C
      file1_id = hopen(FILE1_NAME, DFACC_CREATE, 0)
C
C     Initialize the VS interface associated with the first HDF file.
C
      status = vfstart(file1_id)
C
C     Create a vdata in the first HDF file.
C
      vdata_ref = -1
      vdata_id = vsfatch(file1_id, vdata_ref, ’w’)
C
C     Assign a name to the vdata.
C
      status = vsfsnam(vdata_id, VDATA_NAME)
C
C     Other operations on the vdata identified by vdata_id can be carried out
C     starting from this point.
C
C     Create the second HDF file.
C
      file2_id = hopen(FILE2_NAME, DFACC_CREATE, 0)
C
C     Initialize the VS interface associated with the second HDF file.
C
      status = vfstart(file2_id)
C
C     Create the first vdata in the second HDF file.
C
      vdata1_id = vsfatch(file2_id, vdata_ref, ’w’)
C
C     Create the second vdata in the second HDF file.
C
      vdata2_id = vsfatch(file2_id, vdata_ref, ’w’)
C
C     Assign a class name to these vdatas.
C
      status = vsfscls(vdata1_id, VDATA_CLASS)
      status = vsfscls(vdata2_id, VDATA_CLASS)
C
C     Other operations on the vdatas identified by vdata1_id and vdata2_id
C     can be carried out starting from this point.
C
C
C     Terminate access to the first vdata in the second HDF file.
C
      status = vsfdtch(vdata1_id)
C
C     Terminate access to the second vdata in the second HDF file.
C
      status = vsfdtch(vdata2_id)
C
C     Terminate access to the VS interface associated with the second HDF file.
```

```
C
      status = vfend(file2_id)
C
C     Close the second HDF file.
C
      status = hclose(file2_id)
C
C     Terminate access to the vdata in the first HDF file.
C
      status = vsfdtch(vdata_id)
C
C     terminate access to the VS interface associated with the first HDF file.
C
      status = vfend(file1_id)
C
C     Close the first HDF file.
C
      status = hclose(file1_id)
      end
```

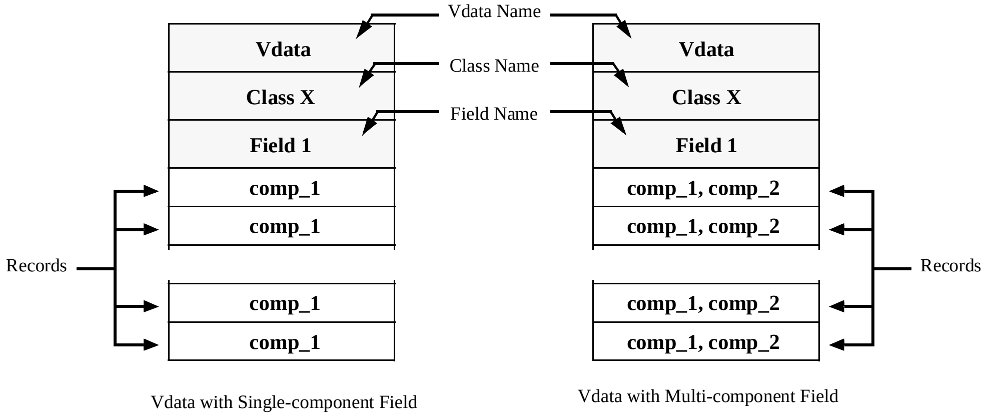
4.4 Creating and Writing to Single-Field Vdatas: VHstoredata and VHstoredatam

There are two methods of writing vdatas that contain one field per record. One requires the use of several VS routines and the other involves the use of **VHstoredata** or **VHstoredatam**, two high-level routines that encapsulate several VS routines into one.

The high-level VH routines are useful when writing one-field vdatas and complete information about each vdata is available. If you cannot provide full information about a vdata, you must use the VS routines described in the next section.

Figure 4c shows two examples of single-field vdatas. The fields can be single-component or multi-component fields. With a multi-component field, they may contain one or more values of the same data type.

FIGURE 4c **Single- and Multi-component Vdatas**



VHstoredata creates then writes a vdata with one single-component field. **VHstoredatam** creates and writes a vdata with one multi-component field. In both cases the following steps are involved:

1. Open the file.
2. Initialize the Vdata interface.

3. Store (create then write to) the vdata.
4. Terminate access to the Vdata interface.
5. 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);

            /* Either VHstoredata or VHstoredatam can be called here. */
            vdata_ref = VHstoredata(file_id, fieldname, buf, n_records,
                             data_type, vdata_name, vdata_class);
    OR      vdata_ref = VHstoredatam(file_id, fieldname, buf, n_records,
                             data_type, vdata_name, vdata_class, order);

            status = Vend(file_id);
            status = Hclose(file_id);

FORTRAN:    file_id = hopen(filename, file_access_mode, num_dds_block)
            status = vfstart(file_id)

C           Either vhfsd/vhfscd or vhfsdm/vhfscdm can be called here.
            vdata_ref = vhfsd(file_id, fieldname, buf, n_records, data_type,
                             vdata_name, vdata_class)
    OR      vdata_ref = vhfscd(file_id, fieldname, buf, n_records, data_type,
                             vdata_name, vdata_class)

            OR

            vdata_ref = vhfsdm(file_id, fieldname, buf, n_records, data_type,
                             vdata_name, vdata_class, order)
    OR      vdata_ref = vhfscdm(file_id, fieldname, buf, n_records, data_type,
                             vdata_name, vdata_class, order)

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

The first seven parameters of **VHstoredata** and **VHstoredatam** are the same. The parameter `file_id` is the file identifier returned by **Hopen**. The parameter `fieldname` specifies the name of the vdata field. The parameter `buf` contains the data to be stored into the vdata. In C, the data type of the parameter `buf` is `uint8`; in FORTRAN-77, it is the data type of the data to be stored. The parameters `n_records` and `data_type` contain the number of records in the vdata and the data type of the vdata data. The parameters `vdata_name` and `vdata_class` specify the name and class of the vdata. The parameter `order` of **VHstoredatam** specifies the order of the field. The maximum length of the vdata name is given by the `VSNAMELENMAX` (or `64`) as defined in the header file "hlimits.h".

Note that these two routines do not overwrite existing vdatas but only create new ones before storing the data.

The FORTRAN-77 version of **VHstoredata** has two routines: **vhfsd** for numeric data and **vhfscd** for character data; the FORTRAN-77 version of **VHstoredatam** has two routines: **vhfsdm** for numeric data and **vhfscdm** for character data.

Both routines return the reference number of the newly-created vdata or `FAIL` (or `-1`) if the operation is unsuccessful. The parameters for **VHstoredata** and **VHstoredatam** are further described in Table 4C.

TABLE 4C

VHstoredata and VHstoredatam Parameter Lists

Routine Name [Return Type] **(FORTRAN-77)**	Parameter	Parameter Type		Description
		C	FORTRAN-77	
VHstoredata [int32] **(vhfsd/vhfscd)**	file_id	int32	integer	File identifier
	fieldname	char *	character*(*)	String containing the name of the field
	buf	uint8 *	<valid numeric data type>(*)/character*(*)	Buffer containing the data to be stored
	n_records	int32	integer	Number of records to create in the vdata
	data_type	int32	integer	Data type of the stored data
	vdata_name	char *	character*(*)	Name of the vdata
	vdata_class	char *	character*(*)	Class name of the vdata
VHstoredatam [int32] **(vhfsdm/ vhfscdm)**	file_id	int32	integer	File identifier
	fieldname	char *	character*(*)	String containing the name of the field
	buf	uint8 *	<valid numeric data type>(*)/character*(*)	Buffer containing the data to be stored
	n_records	int32	integer	Number of records to create in the vdata
	data_type	int32	integer	Data type of the stored data
	vdata_name	char *	character*(*)	Name of the vdata
	vdata_class	char *	character*(*)	Class name of the vdata
	order	int32	integer	Number of field components

EXAMPLE 2.

Creating and Storing One-field Vdatas Using VHstoredata and VHstoredatam

This example illustrates the use of **VHstoredata/vhfscd** and **VHstoredatam/vhfsdm** to create single-field vdatas.

This example creates and writes two vdatas to the file "General_Vdatas.hdf". The first vdata is named "First Vdata", contains 5 records, and belongs to a class named "5x1 Array". The second vdata is named "Second Vdata", contains 6 records, and belongs to a class named "6x4 Array". The field of the first vdata is a single-component field, i.e., order of 1, and named "Single-component Field". The field of the second vdata has an order of 4 and is named "Multi-component Field".

In these examples two vdatas are created. The first vdata has five records with one field of order 1 and is created from a 5 x 1 array in memory. The second vdata has six records with one field of order 4 and is created from a 6 x 4 array in memory.

C:

```
#include "hdf.h"

#define  FILE_NAME      "General_Vdatas.hdf"
#define  CLASS1_NAME    "5x1 Array"
#define  CLASS2_NAME    "6x4 Array"
#define  VDATA1_NAME    "First Vdata"
#define  VDATA2_NAME    "Second Vdata"
#define  FIELD1_NAME    "Single-component Field"
#define  FIELD2_NAME    "Multi-component Field"
#define  N_RECORDS_1    5    /* number of records the first vdata contains  */
#define  N_RECORDS_2    6    /* number of records the second vdata contains */
#define  ORDER_2        4    /* order of the field in the second vdata      */
                /* Note that the order of the field in the first vdata is 1 */

main( )
```

```
{
   /************************* Variable declaration **************************/

   intn  status_n;      /* returned status for functions returning an intn  */
   int32 status_32;     /* returned status for functions returning an int32 */
   int32 file_id, vdata1_ref, vdata2_ref;

   /*
   * Define an array to buffer the data of the first vdata.
   */
   char8 vdata1_buf [N_RECORDS_1] = {’V’, ’D’, ’A’, ’T’, ’A’};

   /*
   * Define an array to buffer the data of the second vdata.
   */
   int32 vdata2_buf [N_RECORDS_2][ORDER_2] = {{1, 2, 3, 4}, {2, 4, 6, 8},
                                              {3, 6, 9, 12}, {4, 8, 12, 16},
                                             {5, 10, 15, 20}, {6, 12, 18, 24}};

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

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

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

   /*
   * Create the first vdata and populate it with data from the vdata1_buf
   * array. Note that the buffer vdata1_buf is cast to (uint8 *) for the
   * benefit of generic data type.
   */
   vdata1_ref = VHstoredata (file_id, FIELD1_NAME, (uint8 *)vdata1_buf,
                       N_RECORDS_1, DFNT_CHAR8, VDATA1_NAME, CLASS1_NAME);

   /*
   * Create the second vdata and populate it with data from the vdata2_buf
   * array.
   */
   vdata2_ref = VHstoredatam (file_id, FIELD2_NAME, (uint8 *)vdata2_buf,
               N_RECORDS_2, DFNT_INT32, VDATA2_NAME, CLASS2_NAME, ORDER_2);

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

FORTRAN:

```
      program create_onefield_vdatas
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      character*9  CLASS1_NAME
      character*9  CLASS2_NAME
      character*11 VDATA1_NAME
      character*12 VDATA2_NAME
      character*22 FIELD1_NAME
      character*21 FIELD2_NAME
      integer      N_RECORDS_1, N_RECORDS_2
      integer      ORDER_2
C
      parameter (FILE_NAME   = ’General_Vdatas.hdf’,
     +           CLASS1_NAME = ’5x1 Array’,
     +           CLASS2_NAME = ’6x4 Array’,
     +           VDATA1_NAME = ’First Vdata’,
     +           VDATA2_NAME = ’Second Vdata’,
     +           FIELD1_NAME = ’Single-component Field’,
     +           FIELD2_NAME = ’Multi-component Field’)
      parameter (N_RECORDS_1 = 5,
     +           N_RECORDS_2 = 6,
     +           ORDER_2     = 4)

      integer DFACC_WRITE, DFNT_CHAR8, DFNT_INT32
      parameter (DFACC_WRITE = 2,
     +           DFNT_CHAR8  = 4,
     +           DFNT_INT32  = 24)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vhfscd, vhfsdm, vfend

C
C**** Variable declaration *******************************************
C
      integer   status
      integer   file_id
      integer   vdata1_ref, vdata2_ref
      character vdata1_buf(N_RECORDS_1)
      integer   vdata2_buf(ORDER_2, N_RECORDS_2)
      data vdata1_buf /’V’,’D’,’A’,’T’,’A’/
      data vdata2_buf / 1,  2,  3,  4,
     +                  2,  4,  6,  8,
     +                  3,  6,  9, 12,
     +                  4,  8, 12, 16,
     +                  5, 10, 15, 20,
     +                  6, 12, 18, 24/
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 VS interface.
C
      status = vfstart(file_id)
C
C     Create the first vdata and populate it with data from vdata1_buf array.
C
      vdata1_ref = vhfscd(file_id, FIELD1_NAME, vdata1_buf, N_RECORDS_1,
     +                    DFNT_CHAR8, VDATA1_NAME, CLASS1_NAME)
C
C     Create the second vdata and populate it with data from vdata2_buf array.
C
      vdata2_ref = vhfsdm(file_id, FIELD2_NAME, vdata2_buf, N_RECORDS_2,
     +                    DFNT_INT32, VDATA2_NAME, CLASS2_NAME,
     +                    ORDER_2)
C
C     Terminate access to the VS interface and close the HDF file.
C
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.5 Writing to Multi-Field Vdatas

There are several steps involved in creating ***general vdatas*** with more than one field: define the vdata, define the fields of the vdata, and write the vdata to the file. These steps are usually executed within a single program, although it is also possible to define an empty vdata in anticipation of writing data to it at a later time.

4.5.1 Creating Vdatas

Creating an empty vdata involves the following steps:

1. Open a file.
2. Initialize the Vdata interface.
3. Create the new vdata.
4. Assign a vdata name. (optional)
5. Assign a vdata class. (optional)
6. Define the fields.
7. Initialize fields for writing.
8. Set the interlace mode.
9. Dispose of the vdata identifier.
10. Terminate access to the Vdata interface.
11. Close the file.

Like the high-level VH interface, the Vdata interface does not retain default settings from one operation to the next or from one file to the next. Each time a vdata is created, its definitions must be explicitly reset.

To create a multi-field vdata, the calling program must contain the following:

```
C:          file_id = Hopen(filename, file_access_mode, num_dds_block);
            status = Vstart(file_id);
            vdata_id = VSattach(file_id, -1, vdata_access_mode);
            status = VSsetname(vdata_id, vdata_name);
            status = VSsetclass(vdata_id, vdata_class);
            status = VSfdefine(vdata_id, fieldname1, data_type1, order1);
             . . . . . . . . . .
            status = VSfdefine(vdata_id, fieldnameN, data_typeN, orderN);
            status = VSsetfields(vdata_id, fieldname_list);
            status = VSsetinterlace(vdata_id, interlace_mode);
            status = VSdetach(vdata_id);
            status = Vend(file_id);
            status = Hclose(file_id);
```

```
FORTRAN:  file_id = hopen(filename, file_access_mode, num_dds_block)
          status = vfstart(file_id)
          vdata_id = vsfatch(file_id, -1, vdata_access_mode)
          status = vsfsnam(vdata_id, vdata_name)
          status = vsfscls(vdata_id, vdata_class)
          status = vsffdef(vdata_id, fieldname1, data_type1, order1)
           . . . . . . . . . .
          status = vsffdef(vdata_id, fieldnameN, data_typeN, orderN)
          status = vsfsfld(vdata_id, fieldname_list)
          status = vsfsint(vdata_id, interlace_mode)
          status = vsfdtch(vdata_id)
          status = vfend(file_id)
          status = hclose(file_id)
```

In the routines that follow, `vdata_id` is the vdata identifier returned by **VSattach**.

4.5.1.1 Assigning a Vdata Name and Class: VSsetname and VSsetclass

VSsetname assigns a name to a vdata. If not explicitly named by a call to **VSsetname**, the name of the vdata is set by default to `NULL`. A name may be assigned and reassigned at any time after the vdata is created. The parameter `vdata_name` contains the name to be assigned to the vdata.

VSsetclass assigns a class to a vdata. If **VSsetclass** is not called, the vdata's class is set by default to `NULL`. As with the vdata name, the class may be assigned and reassigned any time after the vdata is created. The parameter `vdata_class` contains the class name to be assigned to the vdata.

VSsetname and **VSsetclass** return either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters for these routines are further defined in Table 4E on page 143.

4.5.1.2 Defining a Field within a Vdata: VSfdefine

VSfdefine defines a field within a newly-created vdata. Each **VSfdefine** call assigns the name contained in the argument `fieldname`, the data type contained in the argument `data_type`, and the order contained in the argument `order` to one new field. Once data is written to a vdata, the name, data type and order of the field may not be modified or deleted.

The Vdata interface also provides certain ***predefined fields***. A predefined field has a specific name, data type, and order, so there is no need to call **VSfdefine** to define a predefined field. Some applications may require the use of predefined fields in vdatas. Available predefined fields are discussed in Table 4D.

Note that **VSfdefine** does not allocate memory for the field, but simply introduces the field. The field definition must be completed by **VSsetfields**, which is discussed in Section 4.5.1.3 on page 142.

VSfdefine returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters for **VSfdefine** are further described in Table 4E on page 143.

TABLE 4D

Predefined Data Types and Field Names for Vdata Fields

Data Type	Coordinate Point Field Names			Normal Component Field Names		
	x-coordinate	y-coordinate	z-coordinate	x-component	y-component	z-component
float	PX	PY	PZ	NX	NY	NZ
integer	IX	IY	IZ	None	None	None

4.5.1.3 Initializing the Fields for Write Access: VSsetfields

VSsetfields initializes read and write access to the fields in a vdata. It must be called prior to read or write operations. Initializing for read access is discussed in Section 4.6.1 on page 157. For writing, **VSsetfields** specifies the fields to be written and the order in which they are to be placed.

The parameter fieldname_list is a comma-separated list of the field names, with no white space included. The fields can be either the predefined fields or the fields that have been previously introduced by **VSfdefine**. **VSfdefine** allows a user to declare a field, along with its data type and order, but **VSsetfields** finalizes the definition by allowing the user to select the fields that are to be included in the vdata. Thus, any fields created by **VSfdefine** that are not in the parameter fieldname_list of **VSsetfields** will be ignored. This feature was originally intended for interactive-mode users. The combined width of the fields in the parameter fieldname_list is also the length of the record and must be less than MAX_FIELD_SIZE (or 65535). An attempt to create a larger record will cause **VSsetfields** to return FAIL (or -1).

VSsetfields returns either SUCCEED (or 0) or FAIL (or -1). The parameters for **VSsetfields** are further defined in Table 4E on page 143.

4.5.1.4 Specifying the Interlace Mode: VSsetinterlace

The Vdata interface supports two types of interlacing: ***file interlacing*** and ***buffer interlacing***. File interlacing determines how data is stored in a file and buffer interlacing determines how data is stored in memory. The Vdata interface can write data from a buffer to a file in an interlaced or non-interlaced manner. It can also read data from a file in an interlaced or non-interlaced manner.

The **VSread** and **VSwrite** routines set the buffer's interlace mode. The **VSwrite** routine will be discussed in Section 4.5.2.2 on page 145 and the **VSread** routine will be discussed in Section 4.6.2 on page 157.

VSsetinterlace sets the file interlacing mode for a vdata. Setting the parameter interlace_mode to FULL_INTERLACE (or 0) fills the vdata by record, whereas specifying NO_INTERLACE (or 1) fills the vdata by field. (See Figure 4d.) For multi-component fields, all components are treated as a single field.

As with file interlacing, the default buffer interlace mode is FULL_INTERLACE because it is more efficient to write complete records than it is to write fields if the file and buffer interlace modes are the same, although both require the same amount of disk space.

In Figure 4d, the illustrated vdata has four fields and three records.

FIGURE 4d **Interlaced and Non-Interlaced Vdata Contents**

Vdata			
Mixed_Data_Type			
Temp	**Height**	**Speed**	**Ident**
1.11	**1**	**11.11**	**A**
2.22	**2**	**22.22**	**B**
3.33	**3**	**33.33**	**C**

Interlacing Mode: FULL_INTERLACE

Vdata			
Mixed_Data_Type			
Temp	**1.11**	**2.22**	**3.33**
Height	**1**	**2**	**3**
Speed	**11.11**	**22.22**	**33.33**
Ident	**A**	**B**	**C**

Interlacing Mode: NO_INTERLACE

VSsetinterlace can only be used for operations on new vdatas as the interlacing cannot be changed once the data has been written to a vdata. Records in a fully interlaced vdata can be written record-by-record and, thus, can be appended; however, all records in a non-interlaced vdata must be written at the same time.

VSsetinterlace returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters for **VSsetinterlace** are further described in Table 4E.

TABLE 4E **VSsetname, VSsetclass, VSfdefine, VSsetfields, and VSsetinterlace Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSsetname [int32] **(vsfsnam)**	vdata_id	int32	integer	Vdata identifier
	vdata_name	char *	character*(*)	Vdata name
VSsetclass [int32] **(vsfscls)**	vdata_id	int32	integer	Vdata identifier
	vdata_class	char *	character*(*)	Vdata name
VSfdefine [intn] **(vsffdef)**	vdata_id	int32	integer	Vdata identifier
	fieldname	char *	character*(*)	Name of the field to be defined
	data_type	int32	integer	Type of the field data
	order	int32	integer	Order of the new field
VSsetfields [intn] **(vsfsfld)**	vdata_id	int32	integer	Vdata identifier
	fieldname_list	char *	character*(*)	Names of the vdata fields to be accessed
VSsetinterlace [intn] **(vsfsint)**	vdata_id	int32	integer	Vdata identifier
	interlace_mode	int32	integer	Interlace mode

4.5.2 Writing Data to Vdatas

This section describes the vdata writing operation (**VSwrite**), random access to vdata (**VSseek**), and packing and unpacking mechanisms that allow storing vdata fields of different data types (**VSfpack**).

Writing to a vdata requires the following steps:

1. Open a file.
2. Initialize the Vdata interface.
3. Initialize fields for writing.
4. Initiate access to the vdata.
5. Seek to the target record.
6. Write the data.
7. Dispose of the vdata identifier.
8. Terminate access to the Vdata interface.
9. 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);
          vdata_id = VSattach(file_id, vdata_ref, vdata_access_mode);
          status = VSsetfields(vdata_id, fieldname_list);
          record_pos = VSseek(vdata_id, record_index);
          num_of_recs = VSwrite(vdata_id, databuf, n_records, interlace_mode);
          status = VSdetach(vdata_id);
          status = Vend(file_id);
          status = Hclose(file_id);
```

```
FORTRAN:  file_id = hopen(filename, file_access_mode, num_dds_block)
          status = vfstart(file_id)
          vdata_id = vsfatch(file_id, vdata_ref, vdata_access_mode)
          status = vsfsfld(vdata_id, fieldname_list);
          record_pos = vsfseek(vdata_id, record_index);

          num_of_recs = vsfwrt(vdata_id, databuf, n_records, interlace_mode)
      OR  num_of_recs = vsfwrtc(vdata_id, databuf, n_records, interlace_mode)
      OR  num_of_recs = vsfwrit(vdata_id, databuf, n_records, interlace_mode)

          status = vsfdtch(vdata_id)
          status = vfend(file_id)
          status = hclose(file_id)
```

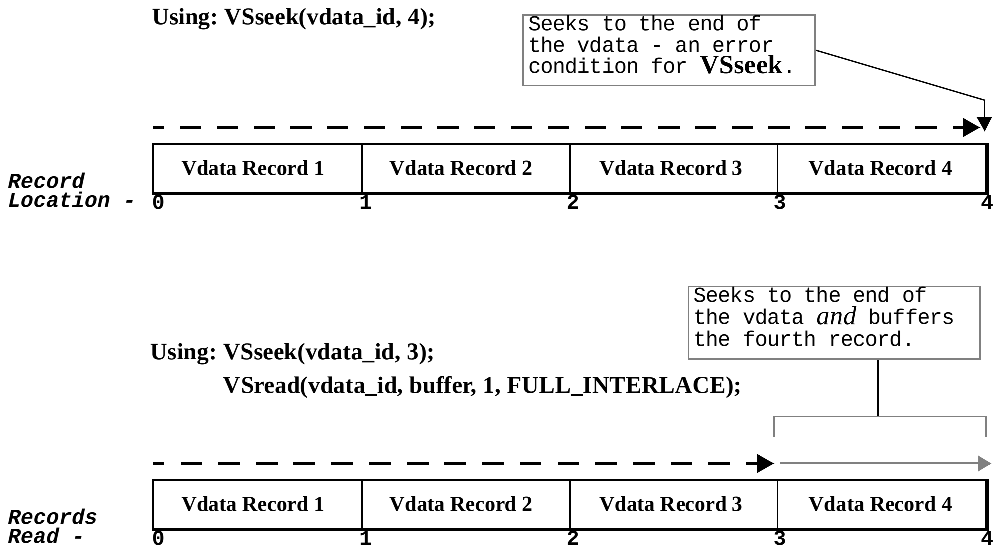
4.5.2.1 Resetting the Current Position within Vdatas: VSseek

VSseek provides a mechanism for random access to fully-interlaced vdatas. Random-access for non-interlaced vdatas is not available. The parameter `record_index` is the position of the record to be written. The position of the first record in a vdata is specified by `record_index` = `0`. Any vdata operation will be performed on this record by default; vdata operations on other records require that **VSseek** be called first to specify the target record.

Note that **VSseek** has been designed for the purpose of *overwriting* data, not *appending* data. That means **VSseek** puts the current record pointer at the beginning of the sought record and the subsequent write will overwrite the record. To append data to a vdata, the current record pointer must be put at the end of the last record. Thus, you must seek to the last record then read this record so that the current record pointer will be put at the end of the record. A write operation will now start at the end of the last record in the vdata. Figure 4e illustrates a situation where **VSseek** can be misused while attempting to append data to the vdata and how **VSread** is called to correctly place the record pointer at the end of the vdata for appending.

Note that, because the record location numbering starts at 0, the record location and the value of the parameter `record_index` are off by 1. For example, reading the fourth record in the buffer requires `record_index` to be set to 3.

FIGURE 4e **Setting the Record Pointer to the End of a Vdata**


Using: VSseek(vdata_id, 4);
Seeks to the end of the vdata - an error condition for VSseek.
Record Location -
Vdata Record 1
Vdata Record 2
Vdata Record 3
Vdata Record 4
0
1
2
3
4
Seeks to the end of the vdata and buffers the fourth record.
Using: VSseek(vdata_id, 3);
VSread(vdata_id, buffer, 1, FULL_INTERLACE);
Records Read -
Vdata Record 1
Vdata Record 2
Vdata Record 3
Vdata Record 4
0
1
2
3
4

In this illustration, the vdata to which we plan to append data contains 4 records. Using **VSseek** to seek to the end of the fourth record by setting the parameter `record_index` to 4 results in an error condition. Setting the parameter `record_index` to 3 places the current record pointer at the beginning of the fourth record. We then use **VSread** to read the contents of the fourth record into a buffer; this moves the current record pointer to the end of the fourth record. The contents of the buffer can then be discarded and a write operation can be called to append data to the end of the vdata.

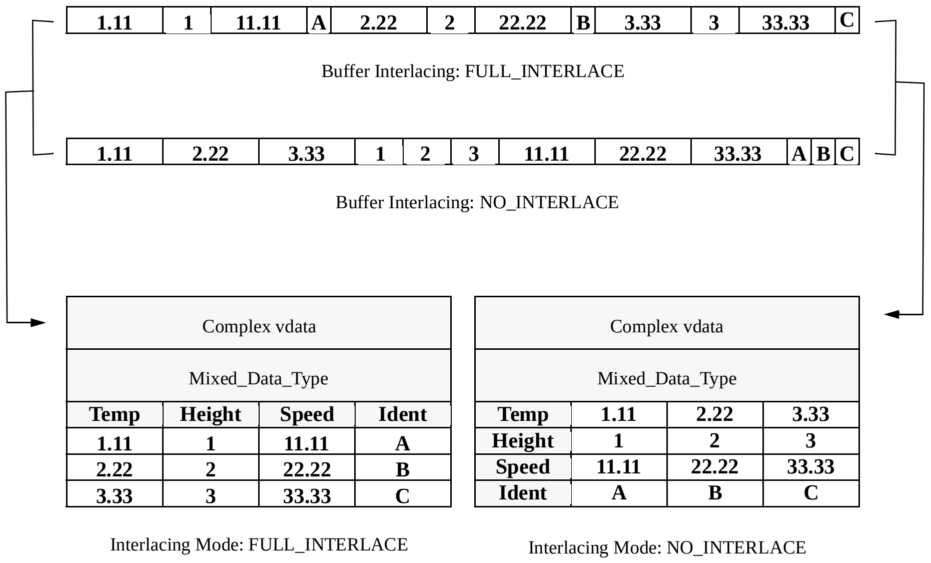
VSseek returns the sought record location or `FAIL` (or `-1`). Its parameters are further defined in Table 4F.

4.5.2.2 Writing to a Vdata: VSwrite

VSwrite writes buffered data to a specified vdata. The parameter `databuf` is a buffer containing the records to be stored in the vdata. The parameter `n_records` specifies the number of records to be stored.

Recall that the *file interlacing* is set by **VSsetinterlace** when the vdata is created, and the *buffer interlacing* is specified by the parameter `interlace_mode` in the call to **VSwrite** when data is written to the file. The array `databuf` is assumed to be organized in memory as specified by `interlace_mode`. Setting `interlace_mode` to `FULL_INTERLACE` (or `0`) indicates that the array in memory is organized by record, whereas to `NO_INTERLACE` (or `1`) indicates that the array is organized by field. (See Figure 4f.) **VSwrite** will write interlaced or non-interlaced data to a vdata in a file: interlaced data in the buffer can be written to the vdata in the file as non-interlaced data and vice versa. If the data is to be stored with an interlace mode different from that of the buffer, **VSsetinterlace** (described in Section 4.5.1.4 on page 142) must be called prior to **VSwrite**. Multiple write operations can only be used on fully-interlaced vdatas in the file.

FIGURE 4f **Writing Interlaced or Non-interlaced Buffers into Interlaced or Non-interlaced Vdatas**



1.11	1	11.11	A	2.22	2	22.22	B	3.33	3	33.33	C

Buffer Interlacing: FULL_INTERLACE

1.11	2.22	3.33	1	2	3	11.11	22.22	33.33	A	B	C

Buffer Interlacing: NO_INTERLACE

Complex vdata

Mixed_Data_Type

Temp	Height	Speed	Ident
1.11	1	11.11	A
2.22	2	22.22	B
3.33	3	33.33	C

Interlacing Mode: FULL_INTERLACE

Complex vdata

Mixed_Data_Type

Temp	1.11	2.22	3.33
Height	1	2	3
Speed	11.11	22.22	33.33
Ident	A	B	C

Interlacing Mode: NO_INTERLACE

The data in the array `databuf` is assumed to contain the exact amount of data in the order needed to fill the fields defined in the last call to **VSsetfields**. Because **VSwrite** writes the contents of `databuf` contiguously to the vdata, any "padding" due to record alignment must be removed before attempting to write from `databuf` to the vdata. For more information on alignment padding see Section 4.5.2.3 on page 150.

It should be remembered that **VSwrite** writes whole records, not individual fields. If a modification to one field within a previously-written record is needed, the contents of the record must first be preserved by reading it to a buffer with **VSread**, which will be described in Section 4.6.2 on page 157; the record must then be updated in the buffer and written back to the file with **VSwrite**.

To store a vdata to the file after being created, either **VSsetname**, **VSsetfields**, or **VSwrite** must be called before **VSdetach** for the vdata. If **VSwrite** is not called, the vdata created will be empty.

The FORTRAN-77 version of **VSwrite** has three routines: **vsfwrt** is for buffered numeric data, **vsfwrtc** is for buffered character data and **vsfwrit** is for generic packed data.

VSwrite returns the total number of records written or `FAIL` (or `-1`). Its parameters are further defined in Table 4F.

TABLE 4F

VSseek and VSwrite Parameter Lists

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSseek [int32] **(vsfseek)**	vdata_id	int32	integer	Vdata identifier
	record_index	int32	integer	Index of the record to seek to
VSwrite [int32] **(vsfwrt/vsfwrtc/ vsfwrit)**	vdata_id	int32	integer	Vdata identifier
	databuf	uint8*	<valid numeric data type>(*) / character*(*) / integer	Buffer containing data to be written
	n_records	int32	integer	Number of records to be written
	interlace_mode	int32	integer	Interlace mode of the buffered data

EXAMPLE 3.

Writing a Vdata of Homogeneous Type

This example illustrates the use of **VSfdefine/vsffdef**, **VSsetname/vsfsnam**, **VSsetclass/vsfscls**, **VSsetfields/vsfsfld**, and **VSwrite/vsfwrt** to create and write a three-field vdata to the file "General_Vdatas.hdf". Although the fields have data of the same type, they have different orders.

To clarify the illustration, let us assume that the vdata is used to contain the data of some particles collected from an experiment. Each record of the data includes the position of a particle, its weight, and the minimum and maximum temperature the particle can endure. The vdata is named "Solid Particle", contains 10 records, and belongs to a class, named "Particle Data". The fields of the vdata include "Position", "Mass", and "Temperature". The field "Position" has an order of 3 for the x, y, and z values representing the position of a particle. The field "Mass" has an order of 1. The field "Temperature" has an order of 2 for the minimum and maximum temperature. The program creates the vdata, sets its name and class name, defines its fields, and then writes the data to it.

C:

```
#include "hdf.h"

#define  FILE_NAME        "General_Vdatas.hdf"
#define  N_RECORDS        10        /* number of records the vdata contains */
#define  ORDER_1          3         /* order of first field */
#define  ORDER_2          1         /* order of second field */
#define  ORDER_3          2         /* order of third field */
#define  CLASS_NAME       "Particle Data"
#define  VDATA_NAME       "Solid Particle"
#define  FIELD1_NAME      "Position"      /* contains x, y, z values */
#define  FIELD2_NAME      "Mass"          /* contains weight values */
#define  FIELD3_NAME      "Temperature"   /* contains min and max values */
```

```
#define  FIELDNAME_LIST   "Position,Mass,Temperature" /* No spaces b/w names */

/* number of values per record */
#define  N_VALS_PER_REC   (ORDER_1 + ORDER_2 + ORDER_3)

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, vdata_id,
          vdata_ref = -1,    /* ref number of a vdata, set to -1 to create  */
          num_of_records;    /* number of records actually written to vdata */
   int16  rec_num;           /* current record number */
   float32  data_buf[N_RECORDS][N_VALS_PER_REC]; /* buffer for vdata values */

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

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

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

   /*
   * Create a new vdata.
   */
   vdata_id = VSattach (file_id, vdata_ref, "w");

   /*
   * Set name and class name of the vdata.
   */
   status_32 = VSsetname (vdata_id, VDATA_NAME);
   status_32 = VSsetclass (vdata_id, CLASS_NAME);

   /*
   * Introduce each field’s name, data type, and order.  This is the first
   * part in defining a field.
   */
   status_n = VSfdefine (vdata_id, FIELD1_NAME, DFNT_FLOAT32, ORDER_1 );
   status_n = VSfdefine (vdata_id, FIELD2_NAME, DFNT_FLOAT32, ORDER_2 );
   status_n = VSfdefine (vdata_id, FIELD3_NAME, DFNT_FLOAT32, ORDER_3 );

   /*
   * Finalize the definition of the fields.
   */
   status_n = VSsetfields (vdata_id, FIELDNAME_LIST);

   /*
   * Buffer the data by the record for fully interlaced mode.  Note that the
   * first three elements contain the three values of the first field, the
   * fourth element contains the value of the second field, and the last two
   * elements contain the two values of the third field.
   */
   for (rec_num = 0; rec_num < N_RECORDS; rec_num++)
   {
      data_buf[rec_num][0] = 1.0 * rec_num;
      data_buf[rec_num][1] = 2.0 * rec_num;
      data_buf[rec_num][2] = 3.0 * rec_num;
      data_buf[rec_num][3] = 0.1 + rec_num;
      data_buf[rec_num][4] = 0.0;
      data_buf[rec_num][5] = 65.0;
   }

   /*
   * Write the data from data_buf to the vdata with full interlacing mode.
   */
   num_of_records = VSwrite (vdata_id, (uint8 *)data_buf, N_RECORDS,
                             FULL_INTERLACE);

   /*
   * Terminate access to the vdata and to the VS interface, then close
   * the HDF file.
   */
   status_32 = VSdetach (vdata_id);
   status_n  = Vend (file_id);
   status_32 = Hclose (file_id);
}
```

FORTRAN:

```
      program write_to_vdata
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      character*13 CLASS_NAME
      character*14 VDATA_NAME
      character*8  FIELD1_NAME
      character*4  FIELD2_NAME
      character*11 FIELD3_NAME
      character*27 FIELDNAME_LIST
      integer      N_RECORDS
      integer      ORDER_1, ORDER_2, ORDER_3
      integer      N_VALS_PER_REC
C
      parameter (FILE_NAME       = ’General_Vdatas.hdf’,
     +           CLASS_NAME      = ’Particle Data’,
     +           VDATA_NAME      = ’Solid Particle’,
     +           FIELD1_NAME     = ’Position’,
     +           FIELD2_NAME     = ’Mass’,
     +           FIELD3_NAME     = ’Temperature’,
     +           FIELDNAME_LIST = ’Position,Mass,Temperature’)
      parameter (N_RECORDS = 10,
     +           ORDER_1   = 3,
     +           ORDER_2   = 1,
     +           ORDER_3   = 2,
     +           N_VALS_PER_REC = ORDER_1 + ORDER_2 + ORDER_3)

      integer DFACC_WRITE, DFNT_FLOAT32, FULL_INTERLACE
      parameter (DFACC_WRITE    = 2,
     +           DFNT_FLOAT32   = 5,
     +           FULL_INTERLACE = 0)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsfsnam, vsfscls, vsffdef, vsfsfld,
     +        vsfwrt, vsfdtch, vfend
```

```
C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, vdata_id
      integer vdata_ref, rec_num, num_of_records
      real    data_buf(N_VALS_PER_REC, N_RECORDS)
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 VS interface.
C
      status = vfstart(file_id)
C
C     Create a new vdata.
C
      vdata_ref = -1
      vdata_id = vsfatch(file_id, vdata_ref, ’w’)
C
C     Set name and class name of the vdata.
C
      status = vsfsnam(vdata_id, VDATA_NAME)
      status = vsfscls(vdata_id, CLASS_NAME)
C
C     Introduce each field’s name, data type, and order. This is the
C     first part in defining a field.
C
      status = vsffdef(vdata_id, FIELD1_NAME, DFNT_FLOAT32, ORDER_1)
      status = vsffdef(vdata_id, FIELD2_NAME, DFNT_FLOAT32, ORDER_2)
      status = vsffdef(vdata_id, FIELD3_NAME, DFNT_FLOAT32, ORDER_3)
C
C     Finalize the definition of the fields.
C
      status = vsfsfld(vdata_id, FIELDNAME_LIST)
C
C     Buffer the data by the record for fully interlaced mode. Note that the
C     first three elements contain the three values of the first field,
C     the forth element contains the value of the second field, and the last two
C     elements contain the two values of the third field.
C
      do 10 rec_num = 1, N_RECORDS
         data_buf(1, rec_num) = 1.0 * rec_num
         data_buf(2, rec_num) = 2.0 * rec_num
         data_buf(3, rec_num) = 3.0 * rec_num
         data_buf(4, rec_num) = 0.1 + rec_num
         data_buf(5, rec_num) = 0.0
         data_buf(6, rec_num) = 65.0
10    continue
C
C     Write the data from data_buf to the vdata with the full interlacing mode.
C
      num_of_records = vsfwrt(vdata_id, data_buf, N_RECORDS,
     +                        FULL_INTERLACE)
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.5.2.3 Packing or Unpacking Field Data: VSfpack

Storing fields of mixed data types is an efficient use of disk space and is useful in applications that use structures. However, while data structures in memory containing fields of variable lengths can contain alignment bytes, field data stored in a vdata cannot include them. This is true for both fully-interlaced and non-interlaced data. Because of this storing limitation, when variable-length field types are used, it is generally not possible to write data directly from a structure in memory into a vdata in a file with a **VSwrite** call or to read data directly into a buffer from the vdata with a call to **VSread**. Thus, when writing, **VSfpack** is used to pack field data into a temporary buffer by removing the padding, or alignment bytes, and when reading, to unpack field data into vdata fields by adding necessary alignment bytes. The syntax for **VSfpack** is as follows:

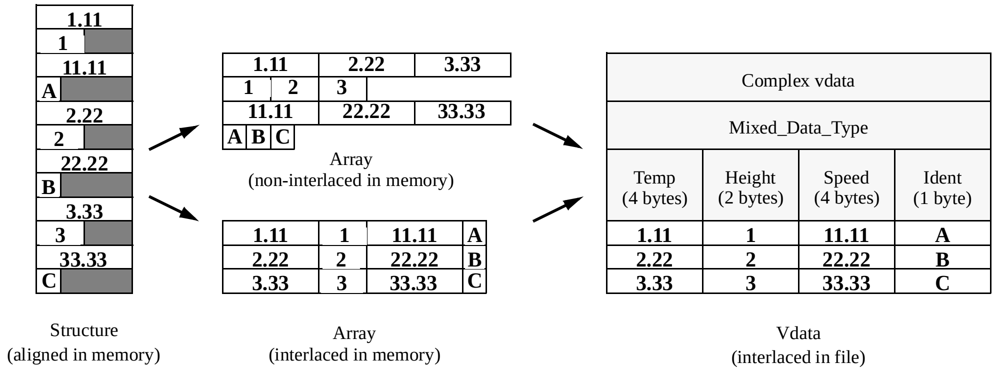
```
C:          status = VSfpack(vdata_id, action, fields_in_buf, buf, buf_size,
                          n_records, fieldname_list, bufptrs);

FORTRAN:    status = vsfcpak(vdata_id, action, fields_in_buf, buf, buf_size,
                          n_records, fieldname_list, bufptrs)

   OR       status = vsfnpak(vdata_id, action, fields_in_buf, buf, buf_size,
                          n_records, fieldname_list, bufptrs)
```

The process of removing the alignment bytes is called “packing the array.” An illustration of this process is provided in Figure 4g. The data provided by the user is stored in the structure in memory. The field values are aligned with padded bytes. **VSfpack** packs the data into the array in memory after removing the padded bytes. The packed data is then written to the vdata in the file by **VSwrite**.

FIGURE 4g **Removing Alignment Bytes When Writing Data From a C Structure to a Vdata**



The process illustrated in Figure 4g can be read in the reverse direction for "unpacking the array," that is when using **VSfpack** to fill a structure in memory with vdata field data. In this case, alignment bytes are added to the field data to make the data conform to the specific alignment requirements of the platform.

VSfpack performs both tasks, packing and unpacking, and the parameter `action` specifies the appropriate action for the routine. Valid values for the parameter `action` are `_HDF_VSPACK` (or `0`) for packing and `_HDF_VSUNPACK` (or `1`) for unpacking.

The calling program must allocate sufficient space for the buffer buf to hold all packed or unpacked fields. The parameter buf_size specifies the size of the buffer buf and should be at least n_records *(the total size of all fields specified in fields_in_buf).

When **VSfpack** is called to pack field values into buf, the parameter fields_in_buf must specify all fields of the vdata. This can be accomplished either by listing all of the field names in fields_in_buf or by setting fields_in_buf to NULL in C or to one blank character in FORTRAN-77.

When **VSfpack** is called to unpack field values, the parameter fields_in_buf may specify a subset of the vdata fields. The parameter fields_in_buf can be set to NULL in C or to one space character in FORTRAN-77 to specify all fields in the vdata.

The parameter fieldname_list specifies the field(s) to be packed or unpacked. The parameter bufptrs provides pointers to the buffers for each field to be packed or unpacked. The calling program is responsible for allocating sufficient space for each field buffer. Significant differences between the C and FORTRAN-77 functionality are described in the following paragraphs.

In C, fieldname_list can list either all of the fields specified by fields_in_buf or a subset of those fields. Only if fields_in_buf specifies all of the vdata fields, then fields_in_buf can be set to NULL to specify all vdata fields. The parameter bufptrs contains an array of pointers to the buffers where field data will be packed or unpacked.

The FORTRAN-77 routines can pack or unpack only one field at a time, so the parameter fieldname_list contains only the name of that field. The parameter bufptrs is the buffer for that field.

The FORTRAN-77 version of **VSfpack** has two routines: **vsfcpak** packs or unpacks character data and **vsfnpak** packs or unpacks numeric data. Refer to the FORTRAN-77 version in Example 4 for a more specific illustration.

VSfpack returns either SUCCEED (or 0) or FAIL (or -1). The parameters for **VSfpack** are described in Table 4G.

TABLE 4G

VSfpack Parameter List

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSfpack [intn] **(vsfcpak/vsfnpak)**	vdata_id	int32	integer	Vdata identifier
	action	intn	integer	Action to be performed
	fields_in_buf	char *	character*(*)	Fields in the buffer buf to write or read from the vdata
	buf	VOIDP	integer	Buffer for the vdata values
	buf_size	intn	integer	Buffer size in bytes
	n_records	intn	integer	Number of records to pack or unpack
	fieldname_list	char *	character*(*)	Names of the fields to be packed or unpacked
	bufptrs	VOIDP	<valid numeric data type>(*)/ character*(*)	Array of pointers to the field buffers in C and field buffer in FORTRAN-77

EXAMPLE 4.

Writing a Multi-field and Mixed-type Vdata with Packing

This example illustrates the use of **VSfpack/vsfnpak/vsfcpak** and **VSwrite/vsfwrit** to write a vdata with data of different types. Note that the approach used in Example 3 makes it difficult for the vdata to have mixed-type data.

In this example, the program creates an HDF file, named "Packed_Vdata.hdf", then defines a vdata which is named "Mixed Data Vdata" and belongs to class "General Data Class". The vdata contains four order-1 fields, "Temp", "Height", "Speed", and "Ident" of type float32, int16, float32, and char8, respectively. The program then packs the data in fully interlaced mode into a databuf and writes the packed data to the vdata. Note that, in the C example, a VSfpack call packs all N_RECORDS and a VSwrite call writes out all N_RECORDS records. In the Fortran example, N_RECORDS of each field are packed using separate calls to vsfnpak and vsfcpak; vsfwrit writes packed data to the vdata.

C:

```
#include "hdf.h"

#define  FILE_NAME        "Packed_Vdata.hdf"
#define  VDATA_NAME       "Mixed Data Vdata"
#define  CLASS_NAME       "General Data Class"
#define  FIELD1_NAME      "Temp"
#define  FIELD2_NAME      "Height"
#define  FIELD3_NAME      "Speed"
#define  FIELD4_NAME      "Ident"
#define  ORDER            1        /* number of values in the field         */
#define  N_RECORDS        20       /* number of records the vdata contains  */
#define  N_FIELDS         4        /* number of fields in the vdata         */
#define  FIELDNAME_LIST   "Temp,Height,Speed,Ident"  /* No spaces b/w names */

/* number of bytes of the data to be written, i.e., the size of all the
   field values combined times the number of records */
#define BUF_SIZE (2*sizeof(float32) + sizeof(int16) + sizeof(char)) * N_RECORDS

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, vdata_id,
         vdata_ref = -1,   /* vdata’s reference number, set to -1 to create */
         num_of_records; /* number of records actually written to the vdata */
   float32 temp[N_RECORDS];       /* buffer to hold values of first field   */
   int16   height[N_RECORDS];     /* buffer to hold values of second field  */
   float32 speed[N_RECORDS];      /* buffer to hold values of third field   */
   char8   ident[N_RECORDS];      /* buffer to hold values of fourth field  */
   VOIDP   fldbufptrs[N_FIELDS];/*pointers to be pointing to the field buff-
ers*/
   uint16  databuf[BUF_SIZE]; /* buffer to hold the data after being packed*/
   int     i;

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

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

   /*
```

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

/*
* Create a new vdata.
*/
vdata_id = VSattach (file_id, vdata_ref, "w");

/*
* Set name and class name of the vdata.
*/
status_32 = VSsetname (vdata_id, VDATA_NAME);
status_32 = VSsetclass (vdata_id, CLASS_NAME);

/*
* Introduce each field’s name, data type, and order.  This is the first
* part in defining a vdata field.
*/
status_n = VSfdefine (vdata_id, FIELD1_NAME, DFNT_FLOAT32, ORDER);
status_n = VSfdefine (vdata_id, FIELD2_NAME, DFNT_INT16, ORDER);
status_n = VSfdefine (vdata_id, FIELD3_NAME, DFNT_FLOAT32, ORDER);
status_n = VSfdefine (vdata_id, FIELD4_NAME, DFNT_CHAR8, ORDER);

/*
* Finalize the definition of the fields of the vdata.
*/
status_n = VSsetfields (vdata_id, FIELDNAME_LIST);

/*
* Enter data values into the field buffers by the records.
*/
for (i = 0; i < N_RECORDS; i++)
{
   temp[i] = 1.11 * (i+1);
   height[i] = i;
   speed[i] = 1.11 * (i+1);
   ident[i] = ’A’ + i;
}

/*
* Build an array of pointers each of which points to a field buffer that
* holds all values of the field.
*/
fldbufptrs[0] = &temp[0];
fldbufptrs[1] = &height[0];
fldbufptrs[2] = &speed[0];
fldbufptrs[3] = &ident[0];

/*
* Pack all data in the field buffers that are pointed to by the set of
* pointers fldbufptrs, and store the packed data into the buffer
* databuf.  Note that the second parameter is _HDF_VSPACK for packing.
*/
status_n = VSfpack (vdata_id,_HDF_VSPACK, NULL, (VOIDP)databuf,
        BUF_SIZE, N_RECORDS, NULL, (VOIDP)fldbufptrs);

/*
* Write all records of the packed data to the vdata.
*/
num_of_records = VSwrite (vdata_id, (uint8 *)databuf, N_RECORDS,
                          FULL_INTERLACE);
   /*
   * Terminate access to the vdata and the VS interface, then close
   * the HDF file.
   */
   status_32 = VSdetach (vdata_id);
   status_n = Vend (file_id);
   status_32 = Hclose (file_id);
}
```

FORTRAN:

```
      program write_mixed_vdata
      implicit none
C
C     Parameter declaration
C
      character*16 FILE_NAME
      character*18 CLASS_NAME
      character*16 VDATA_NAME
      character*4  FIELD1_NAME
      character*6  FIELD2_NAME
      character*5  FIELD3_NAME
      character*5  FIELD4_NAME
      character*23 FIELDNAME_LIST
      integer      N_RECORDS, N_FIELDS, ORDER
      integer      BUF_SIZE
C
      parameter (FILE_NAME       = 'Packed_Vdata.hdf',
     +           CLASS_NAME      = 'General Data Class',
     +           VDATA_NAME      = 'Mixed Data Vdata',
     +           FIELD1_NAME     = 'Temp',
     +           FIELD2_NAME     = 'Height',
     +           FIELD3_NAME     = 'Speed',
     +           FIELD4_NAME     = 'Ident',
     +           FIELDNAME_LIST = 'Temp,Height,Speed,Ident')
      parameter (N_RECORDS = 20,
     +           N_FIELDS  = 4,
     +           ORDER     = 1,
     +           BUF_SIZE = (4 + 2 + 4 + 1)*N_RECORDS)

      integer DFACC_WRITE, DFNT_FLOAT32, DFNT_INT16, DFNT_CHAR8,
     +        FULL_INTERLACE, HDF_VSPACK
      parameter (DFACC_WRITE    = 2,
     +           DFNT_FLOAT32   = 5,
     +           DFNT_INT16     = 22,
     +           DFNT_CHAR8     = 4,
     +           FULL_INTERLACE = 0,
     +           HDF_VSPACK     = 0)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsfsnam, vsfscls, vsffdef, vsfsfld,
     +        vsfnpak, vsfcpak, vsfwrit, vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer   status
      integer   file_id, vdata_id
      integer   vdata_ref, num_of_records
      real      temp(N_RECORDS)
      integer*2 height(N_RECORDS)
      real      speed(N_RECORDS)
      character ident(N_RECORDS)
      integer   i
C
C     Buffer for packed data should be big enough to hold N_RECORDS.
C
      integer   databuf(BUF_SIZE/4 + 1)
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 VS interface.
C
      status = vfstart(file_id)
C
C     Create a new vdata.
C
      vdata_ref = -1
      vdata_id = vsfatch(file_id, vdata_ref, ’w’)
C
C     Set name and class name of the vdata.
C
      status = vsfsnam(vdata_id, VDATA_NAME)
      status = vsfscls(vdata_id, CLASS_NAME)
C
C     Introduce each field’s name, data type, and order. This is the
C     first part in defining a field.
C
      status = vsffdef(vdata_id, FIELD1_NAME, DFNT_FLOAT32, ORDER)
      status = vsffdef(vdata_id, FIELD2_NAME, DFNT_INT16, ORDER)
      status = vsffdef(vdata_id, FIELD3_NAME, DFNT_FLOAT32, ORDER)
      status = vsffdef(vdata_id, FIELD4_NAME, DFNT_CHAR8, ORDER)
C
C     Finalize the definition of the fields.
C
      status = vsfsfld(vdata_id, FIELDNAME_LIST)
C
C     Enter data values into the field databufs by the records.
C
      do 10 i = 1, N_RECORDS
         temp(i)   = 1.11 * i
         height(i) = i - 1
         speed(i)  = 1.11 * i
         ident(i)  = char(64+i)
10    continue
C
C     Pack N_RECORDS of data into databuf. In Fortran, each field is packed
C     using separate calls to vsfnpak or vsfcpak.
C
      status = vsfnpak(vdata_id, HDF_VSPACK, ’ ’, databuf, BUF_SIZE,
     +                 N_RECORDS, FIELD1_NAME, temp)
      status = vsfnpak(vdata_id, HDF_VSPACK, ’ ’, databuf, BUF_SIZE,
     +                 N_RECORDS, FIELD2_NAME, height)
      status = vsfnpak(vdata_id, HDF_VSPACK, ’ ’, databuf, BUF_SIZE,
     +                 N_RECORDS, FIELD3_NAME, speed)
      status = vsfcpak(vdata_id, HDF_VSPACK, ’ ’, databuf, BUF_SIZE,
     +                 N_RECORDS, FIELD4_NAME, ident)
C
C     Write all the records of the packed data to the vdata.
```

```
C
      num_of_records = vsfwrit(vdata_id, databuf, N_RECORDS,
     +                          FULL_INTERLACE)
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.6 Reading from Vdatas

Reading from vdatas is more complicated than writing to vdatas, as it usually involves searching for a particular vdata, then searching *within* that vdata, before actually reading data. The process of reading from vdatas can be summarized as follows:

1. Identify the appropriate vdata in the file.
2. Obtain information about the vdata.
3. Read in the desired data.

Only Step 3 will be covered in this section assuming that the vdata of interest and its data information is known. Step 1 is covered in Section 4.7 on page 165 and Step 2 is covered in Section 4.9 on page 179.

Step 3 can be expanded into the following:

1. Open the file.
2. Initialize the Vdata interface.
3. Initiate access to the vdata.
4. Optionally seek to the appropriate record.
5. Initialize the fields to be read.
6. Read the data.
7. If the fields have different data types, unpack the field data.
8. Terminate access to the vdata.
9. Terminate access to the Vdata interface.
10. Close the file.

The following sequence of function calls corresponds to the above steps:

```
C:        file_id = Hopen(filename, file_access_mode, num_dds_block);
          status = Vstart(file_id);
          vdata_id = VSattach(file_id, vdata_ref, vdata_access_mode);
          record_pos = VSseek(vdata_id, record_index);
          status = VSsetfields(vdata_id, fieldname_list);
          records_read = VSread(vdata_id, databuf, n_records, interlace_mode);
          status = VSfpack(vdata_id, action, fields_in_buf, buf, buf_size,
                           n_records, fieldname_list, bufptrs);
          status = VSdetach(vdata_id);
          status = Vend(file_id);
          status = Hclose(file_id);
```

```
FORTRAN:  file_id = hopen(filename, file_access_mode, num_dds_block)
          status = vfstart(file_id)
          vdata_id = vsfatch(file_id, vdata_ref, vdata_access_mode)
          record_pos = vsfseek(vdata_id, record_index)
          status = vsfsfld(vdata_id, fieldname_list)

          records_read = vsfrd(vdata_id, databuf, n_records, interlace_mode)
   OR     records_read = vsfrdc(vdata_id, databuf, n_records, interlace_mode)

          status = vsfcpak(vdata_id, action, fields_in_buf, buf, buf_size,
                           n_records, fieldname_list, bufptrs)
   OR     status = vsfnpak(vdata_id, action, fields_in_buf, buf, buf_size,
                           n_records, fieldname_list, bufptrs)

          status = vsfdtch(vdata_id)
          status = vfend(file_id)
          status = hclose(file_id)
```

4.6.1 Initializing the Fields for Read Access: VSsetfields

VSsetfields establishes access to the fields to be read by the next read operation. The argument fieldname_list is a comma-separated string of the field names with no white space. The order the field names occur in fieldname_list is the order in which the fields will be read. For example, assume that a vdata contains fields named A, B, C, D, E, F in that order. The following declarations demonstrate how to use fieldname_list to read a single field, a collection of random fields, and all the fields in reverse order:

- Single field: fieldname_list = “B”
- Collection of fields: fieldname_list = “A,E”
- Reverse order: fieldname_list = “F,E,D,C,B,A”

VSsetfields returns either SUCCEED (or 0) or FAIL (or -1). The parameters for **VSsetfields** are further defined in Table 4E on page 143.

4.6.2 Reading from the Current Vdata: VSread

VSread sequentially retrieves data from the records in a vdata. The parameter databuf is the buffer to store the retrieved data, n_records specifies the number of records to retrieve, and interlace_mode specifies the interlace mode, FULL_INTERLACE (or 0) or NO_INTERLACE (or 1), to be used in the contents of databuf.

Prior to the first **VSread** call, **VSsetfields** must be called.

If a **VSread** call is successful, the data returned in databuf is formatted according to the interlace mode specified by the parameter interlace_mode and the data fields appear in the order specified in the last call to **VSsetfields** for that vdata.

By default, **VSread** reads from the first vdata record. To retrieve an arbitrary record from a vdata, use **VSseek** to specify the record position before calling **VSread**. **VSseek** is described in Section 4.5.2.1 on page 144.

The FORTRAN-77 version of **VSread** has three routines: **vsfrd** reads buffered numeric data, **vsfrdc** reads buffered character data and **vsfread** reads generic packed data.

VSread returns the total number of records read if successful and FAIL (or -1) otherwise. The parameters for **VSread** are further defined in Table 4H.

TABLE 4H

VSread Parameter List

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
VSread [int32] **(vsfrd/vsfrdc/ vsfread)**	vdata_id	int32	integer	Vdata identifier
	databuf	uint8*	<valid numeric data type>(*) / character*(*) / integer	Buffer for the retrieved data
	n_records	int32	integer	Number of records to be retrieved
	interlace_mode	int32	integer	Interlace mode of the buffered data

VSsetfields and **VSread** may be called several times to read from the same vdata. However, note that **VSread** operations are sequential. Thus, in the following code segment, the first call to **VSread** returns ten “A” data values from the first ten elements in the vdata, while the second call to **VSread** returns ten “B” data values from the second ten elements (elements 10 to 19) in the vdata.

```
status = VSsetfields(vdata_id, "A");
records_read = VSread(vdata_id, bufferA, 10, interlace_mode);

status = VSsetfields(vdata_id, "B");
records_read = VSread(vdata_id, bufferB, 10, interlace_mode);
```

To read the first ten “B” data values, the access routine **VSseek** must be called to explicitly position the read pointer back to the position of the first record. The following code segment reads the first ten “A” and “B” values into two separate float arrays `bufferA` and `bufferB`.

```
status = VSsetfields(vdata_id, "A");
records_read = VSread(vdata_id, bufferA, 10, interlace_mode);

record_pos = VSseek(vdata_id, 0); /* seeks to first record */
status = VSsetfields(vdata_id, "B");
records_read = VSread(vdata_id, bufferB, 10, interlace_mode);
```

EXAMPLE 5.

Reading a Vdata of Homogeneous Type

This example illustrates the use of **VSfind/vsffnd** to locate a vdata given its name, **VSseek/vsfseek** to move the current position to a desired record, and **VSread/vsfrd** to read the data of several records. The function **VSfind** will be discussed in Section 4.7.3. The approach used in this example can only read data written by a program such as that in Example 3, i.e., without packing. Reading mixed data vdatas must use the approach illustrated in Example 6.

The program reads 5 records starting from the fourth record of the two fields "Position" and "Temperature" in the vdata "Solid Particle" from the file "General_Vdatas.hdf". After the program uses VSfind/vsffnd to obtain the reference number of the vdata, it uses **VSseek/vsfseek** to place the current position at the fourth record, then starts reading 5 records, and displays the data.

C:

```
#include "hdf.h"

#define  FILE_NAME       "General_Vdatas.hdf"
#define  VDATA_NAME      "Solid Particle"
#define  N_RECORDS       5    /* number of records the vdata contains */
#define  RECORD_INDEX    3    /* position where reading starts - 4th record */
#define  ORDER_1         3    /* order of first field to be read */
#define  ORDER_2         2    /* order of second field to be read */
#define  FIELDNAME_LIST  "Position,Temperature" /* only two fields are read */
#define  N_VALS_PER_REC  (ORDER_1 + ORDER_2)
```

```
                         /* number of values per record */

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, vdata_id,
         vdata_ref,     /* vdata's reference number */
         num_of_records, /* number of records actually written to the vdata */
         record_pos;    /* position of the current record */
   int16 i, rec_num;    /* current record number in the vdata */
   float32 databuf[N_RECORDS][N_VALS_PER_REC];   /* buffer for vdata values */

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

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

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

   /*
   * Get the reference number of the vdata, whose name is specified in
   * VDATA_NAME, using VSfind, which will be discussed in Section 4.7.3.
   */
   vdata_ref = VSfind (file_id, VDATA_NAME);

   /*
   * Attach to the vdata for reading if it is found, otherwise
   * exit the program.
   */
   if (vdata_ref == 0) exit;
   vdata_id = VSattach (file_id, vdata_ref, "r");

   /*
   * Specify the fields that will be read.
   */
   status_n = VSsetfields (vdata_id, FIELDNAME_LIST);

   /*
   * Place the current point to the position specified in RECORD_INDEX.
   */
   record_pos = VSseek (vdata_id, RECORD_INDEX);

   /*
   * Read the next N_RECORDS records from the vdata and store the data
   * in the buffer databuf with fully interlaced mode.
   */
   num_of_records = VSread (vdata_id, (uint8 *)databuf, N_RECORDS,
                            FULL_INTERLACE);

   /*
   * Display the read data as many records as the number of records
   * returned by VSread.
   */
   printf ("\n       Particle Position        Temperature Range\n\n");
   for (rec_num = 0; rec_num < num_of_records; rec_num++)
   {
      printf ("   %6.2f, %6.2f, %6.2f        %6.2f, %6.2f\n",
        databuf[rec_num][0], databuf[rec_num][1], databuf[rec_num][2],
        databuf[rec_num][3], databuf[rec_num][4]);
   }

   /*
   * Terminate access to the vdata and to the VS interface, then close
   * the HDF file.
   */
   status_32 = VSdetach (vdata_id);
   status_n = Vend (file_id);
   status_32 = Hclose (file_id);
}
```

FORTRAN:

```
      program read_from_vdata
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      character*14 VDATA_NAME
      character*20 FIELDNAME_LIST
      integer      N_RECORDS, RECORD_INDEX
      integer      ORDER_1, ORDER_2
      integer      N_VALS_PER_REC
C
      parameter (FILE_NAME       = ’General_Vdatas.hdf’,
     +           VDATA_NAME      = ’Solid Particle’,
     +           FIELDNAME_LIST = ’Position,Temperature’)
      parameter (N_RECORDS  = 5,
     +           RECORD_INDEX = 3,
     +           ORDER_1    = 3,
     +           ORDER_2    = 2,
     +           N_VALS_PER_REC = ORDER_1 + ORDER_2 )

      integer DFACC_READ, FULL_INTERLACE
      parameter (DFACC_READ     = 1,
     +           FULL_INTERLACE = 0)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsffnd, vsfatch, vsfsfld, vsfrd, vsfseek,
     +        vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, vdata_id
      integer vdata_ref, rec_num, num_of_records, rec_pos
      real    databuf(N_VALS_PER_REC, N_RECORDS)
      integer i
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 VS interface.
C
      status = vfstart(file_id)
C
C     Get the reference number of the vdata, whose name is specified in
C     VDATA_NAME, using vsffnd, which will be discussed in Section 4.7.3.
C
      vdata_ref = vsffnd(file_id, VDATA_NAME)
C
C     Attach to the vdata for reading if it is found,
C     otherwise exit the program.
C
      if (vdata_ref .eq. 0) stop
      vdata_id = vsfatch(file_id, vdata_ref, 'r')
C
C     Specify the fields that will be read.
C
      status = vsfsfld(vdata_id, FIELDNAME_LIST)
C
C     Place the current point to the position specified in RECORD_INDEX.
C
      rec_pos = vsfseek(vdata_id, RECORD_INDEX)
C
C     Read the next N_RECORDS from the vdata and store the data in the buffer
C     databuf with fully interlace mode.
C
      num_of_records = vsfrd(vdata_id, databuf, N_RECORDS,
     +                        FULL_INTERLACE)
C
C     Display the read data as many records as the number of records returned
C     by vsfrd.
C
      write(*,*) '  Particle Position     Temperature Range'
      write(*,*)
      do 10 rec_num = 1, num_of_records
         write(*,1000) (databuf(i, rec_num), i = 1, N_VALS_PER_REC)
10    continue
1000  format(1x,3(f6.2), 8x,2(f6.2))
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

EXAMPLE 6.

Reading a Multi-field and Mixed-type Vdata with Packing

This example illustrates the use of **VSread/vsfread** to read part of a mixed data vdata and **VSfpack/vsfnpak/vsfcpak** to unpack the data read.

The program reads the vdata "Mixed Data Vdata" that was written to the file "Packed_Vdata.hdf" by the program in Example 4. In Example 6, all values of the fields "Temp" and "Ident" are read. The program unpacks and displays all the values after reading is complete. Again, note that in C only one call to **VSread** and one call to **VSfpack** are made to read and unpack all N_RECORDS records. In Fortran, data is read with one call to **vsfread**, but each field is unpacked using separate calls to **vsfnpak** and **vsfcpak**

C:

```
#include "hdf.h"

#define  N_RECORDS       20      /* number of records to be read */
#define  N_FIELDS        2       /* number of fields to be read */
#define  FILE_NAME       "Packed_Vdata.hdf"
#define  VDATA_NAME      "Mixed Data Vdata"
#define  FIELDNAME_LIST  "Temp,Ident"

/* number of bytes of the data to be read */
#define  BUFFER_SIZE     ( sizeof(float32) + sizeof(char)) * N_RECORDS

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, vdata_id,
         num_of_records,        /* number of records actually read */
         vdata_ref,             /* reference number of the vdata to be read */
         buffer_size;           /* number of bytes the vdata can hold       */
   float32 itemp[N_RECORDS];    /* buffer to hold values of first field     */
   char  idents[N_RECORDS];     /* buffer to hold values of fourth field    */
   uint8 databuf[BUFFER_SIZE];  /* buffer to hold read data, still packed   */
   VOIDP fldbufptrs[N_FIELDS];/*pointers to be pointing to the field buffers*/
   int   i;

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

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

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

   /*
   * Get the reference number of the vdata, whose name is specified in
   * VDATA_NAME, using VSfind, which will be discussed in Section 4.7.3.
   */
   vdata_ref = VSfind (file_id, VDATA_NAME);

   /*
   * Attach to the vdata for reading.
   */
   vdata_id = VSattach (file_id, vdata_ref, "r");

   /*
   * Specify the fields that will be read.
   */
   status_n = VSsetfields(vdata_id, FIELDNAME_LIST);

   /*
   * Read N_RECORDS records of the vdata and store the values into the
   * buffer databuf.
   */
   num_of_records = VSread (vdata_id, (uint8 *)databuf, N_RECORDS,
                            FULL_INTERLACE);
   /*
   * Build an array of pointers each of which points to an array that
   * will hold all values of a field after being unpacked.
   */
   fldbufptrs[0] = &itemp[0];
   fldbufptrs[1] = &idents[0];

   /*
   * Unpack the data from the buffer databuf and store the values into the
   * appropriate field buffers pointed to by the set of pointers fldbufptrs.
   * Note that the second parameter is _HDF_VSUNPACK for unpacking and the
   * number of records is the one returned by VSread.
   */
   status_n = VSfpack (vdata_id, _HDF_VSUNPACK, FIELDNAME_LIST, (VOIDP)databuf,
               BUFFER_SIZE, num_of_records, NULL, (VOIDP)fldbufptrs);

   /*
   * Display the read data being stored in the field buffers.
   */
   printf ("\n     Temp      Ident\n");
   for (i=0; i < num_of_records; i++)
       printf ("   %6.2f        %c\n", itemp[i], idents[i]);

   /*
   * Terminate access to the vdata and the VS interface, then close
   * the HDF file.
   */
   status_32 = VSdetach (vdata_id);
   status_n = Vend (file_id);
   status_32 = Hclose (file_id);
}
```

FORTRAN:

```
      program read_mixed_vdata
      implicit none
C
C     Parameter declaration
C
      character*16 FILE_NAME
      character*16 VDATA_NAME
      character*4  FIELD1_NAME
      character*5  FIELD2_NAME
      character*10 FIELDNAME_LIST
      integer      N_RECORDS, N_FIELDS
      integer      BUFFER_SIZE
C
      parameter (FILE_NAME       = ’Packed_Vdata.hdf’,
     +           VDATA_NAME      = ’Mixed Data Vdata’,
     +           FIELD1_NAME     = ’Temp’,
     +           FIELD2_NAME     = ’Ident’,
     +           FIELDNAME_LIST = ’Temp,Ident’)
      parameter (N_RECORDS   = 20,
     +           N_FIELDS    = 2,
     +           BUFFER_SIZE = (4 + 1)*N_RECORDS)

      integer DFACC_READ, DFNT_FLOAT32, DFNT_CHAR8,
     +        FULL_INTERLACE, HDF_VSUNPACK
      parameter (DFACC_READ       = 1,
     +           DFNT_FLOAT32     = 5,
     +           DFNT_CHAR8       = 4,
     +           FULL_INTERLACE   = 0,
     +           HDF_VSUNPACK     = 1)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsffnd, vsfsfld,
     +        vsfnpak, vsfcpak, vsfread, vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer   status
      integer   file_id, vdata_id
      integer   vdata_ref, num_of_records
      real      temp(N_RECORDS)
      character ident(N_RECORDS)
      integer   i
C
C     Buffer for read packed data should be big enough to hold N_RECORDS.
C
      integer   databuf(BUFFER_SIZE/4 + 1)
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 VS interface.
C
      status = vfstart(file_id)
C
C     Get the reference number of the vdata, whose name is specified in
C     VDATA_NAME, using vsffnd, which will be discussed in Section 4.7.3.
C
      vdata_ref = vsffnd(file_id, VDATA_NAME)
C
C     Attach to the vdata for reading if it is found,
C     otherwise exit the program.
C
      if (vdata_ref .eq. 0) stop
      vdata_id = vsfatch(file_id, vdata_ref, 'r')
C
C     Specify the fields that will be read.
C
      status = vsfsfld(vdata_id, FIELDNAME_LIST)

C
C    Read N_RECORDS records of the vdata and store the values into the databuf.
C
      num_of_records = vsfread(vdata_id, databuf, N_RECORDS,
     +                         FULL_INTERLACE)
C
C     Unpack N_RECORDS from databuf into temp and ident arrays.
C     In Fortran, each field is unpacked using separate calls to
C     vsfnpak or vsfcpak.
C
      status = vsfnpak(vdata_id, HDF_VSUNPACK, FIELDNAME_LIST, databuf,
     +                 BUFFER_SIZE, num_of_records, FIELD1_NAME, temp)
      status = vsfcpak(vdata_id, HDF_VSUNPACK, FIELDNAME_LIST, databuf,
     +                 BUFFER_SIZE, num_of_records, FIELD2_NAME, ident)
C
```

```
C     Display the read data being stored in the field databufs.
C
      write (*,*) '    Temp  Ident'
      do 10 i = 1, num_of_records
         write(*,1000) temp(i), ident(i)
10    continue
1000  format (3x,F6.2, 4x, a)
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.7 Searching for Vdatas in a File

There are several HDF library routines that perform searches for a specific vdata in a file. In this section, we introduce these routines; methods for obtaining information about the members of a given vdata are described in the following section.

4.7.1 Finding All Vdatas that are Not Members of a Vgroup: VSlone

A ***lone vdata*** is one that is not a member of a vgroup. ***Vgroups*** are HDF objects that contain sets of HDF objects, including vgroups. Vgroups are described in Chapter 5, *Vgroups (V API)*.

VSlone searches an HDF file and retrieves the reference numbers of lone vdatas in the file. The syntax of **VSlone** is as follows:

```
C:         num_of_lone_vdatas = VSlone(file_id, ref_array, maxsize);

FORTRAN:   num_of_lone_vdatas = vsflone(file_id, ref_array, maxsize)
```

The parameter ref_array is an array allocated to hold the retrieved reference numbers of lone vdatas and the argument maxsize specifies the maximum size of ref_array. At most, maxsize reference numbers will be returned in ref_array.

The space that should be allocated for ref_array is dependent upon on how many lone vdatas are expected in the file. A size of MAX_FIELD_SIZE (or 65535) integers is adequate to handle any case. To use dynamic memory instead of allocating such a large array, first call **VSlone** with maxsize set to a small value like 0 or 1, then use the returned value to allocate memory for ref_array to be passed to a subsequent call to **VSlone**.

VSlone returns the number of lone vdatas or FAIL (or -1). The parameters for **VSlone** are listed in Table 4I on page 166.

4.7.2 Sequentially Searching for a Vdata: VSgetid

VSgetid sequentially searches through an HDF file to obtain the vdata immediately following the vdata specified by the reference number in the parameter vdata_ref. The syntax of **VSgetid** is as follows:

```
C:         ref_num = VSgetid(file_id, vdata_ref);

FORTRAN:   ref_num = vsfgid(file_id, vdata_ref)
```

To obtain the reference number of the first vdata in the file, the user must set the parameter `vdata_ref` to -1. Thus, **VSgetid** can be repeatedly called, with the initial value of `vdata_ref` set to -1 so that the routine will sequentially return the reference number of each vdata in the file, starting from the first vdata. After the last vdata is reached, subsequent calls to **VSgetid** will return `FAIL` (or `-1`).

VSgetid returns a vdata reference number or `FAIL` (or `-1`). The parameters for **VSgetid** are listed in Table 4I on page 166.

4.7.3 Determining a Reference Number from a Vdata Name: VSfind

VSfind searches an HDF file for a vdata with the specified name and returns the vdata reference number. The syntax of **VSfind** is as follows:

```
C:         ref_num = VSfind(file_id, vdata_name);

FORTRAN:   ref_num = vsffnd(file_id, vdata_name)
```

The parameter `vdata_name` is the search key. Although there may be several identically named vdatas in the file, **VSfind** will only return the reference number of the first vdata in the file with the specified name.

VSfind returns either the vdata reference number if the named vdata is found or `0` otherwise. The parameters for **VSfind** are listed in Table 4I.

4.7.4 Searching for a Vdata by Field Name: VSfexist

VSfexist queries a vdata for a set of specified field names and is often useful for locating vdatas containing particular field names. The syntax of the **VSfexist** function is as follows:

```
C:         status = VSfexist(vdata_id, fieldname_list);

FORTRAN:   status = vsfex(vdata_id, fieldname_list)
```

The parameter `fieldname_list` is a string of comma-separated field names containing no white space, for example, “`PX,PY,PZ`”.

VSfexist returns `SUCCEED` (or `0`) if all of the fields specified in the parameter `fieldname_list` are found and `FAIL` (or `-1`) otherwise. The parameters for **VSfexist** are listed in Table 4I.

TABLE 4I **VSlone, VSgetid, VSfind, and VSfexist Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSlone [int32] **(vsflone)**	file_id	int32	integer	File identifier
	ref_array	int32 []	integer (*)	Buffer for a list of lone vdata reference numbers
	maxsize	int32	integer	Maximum number of reference numbers to be buffered
VSgetid [int32] **(vsfgid)**	file_id	int32	integer	File identifier
	vdata_ref	int32	integer	Reference number of the vdata preceding the vdata
VSfind [int32] **(vsffnd)**	file_id	int32	integer	File identifier
	vdata_name	char *	character*(*)	Name of the vdata to find
VSfexist [intn] **(vsfex)**	vdata_id	int32	integer	Vdata identifier
	fieldname_list	char *	character*(*)	Names of the fields to be queried

EXAMPLE 7.

Locating a Vdata Containing Specified Field Names

This example illustrates the use of **VSgetid/vsfgid** to obtain the reference number of each vdata in an HDF file and the use of **VSfexist/vsfex** to determine whether a vdata contains specific fields.

In this example, the program searches the HDF file "General_Vdatas.hdf" to locate the first vdata containing the fields "Position" and "Temperature". The HDF file is an output of the program in Example 3.

C:

```
#include "hdf.h"

#define  FILE_NAME         "General_Vdatas.hdf"
#define  SEARCHED_FIELDS   "Position,Temperature"

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, vdata_id, vdata_ref,
         index = 0;     /* index of the vdata in the file - manually kept   */
   int8  found_fields;  /* TRUE if the specified fields exist in the vdata  */

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

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

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

   /*
   * Set the reference number to -1 to start the search from
   * the beginning of file.
   */
   vdata_ref = -1;

   /*
   * Assume that the specified fields are not found in the current vdata.
   */
   found_fields = FALSE;

   /*
   * Use VSgetid to obtain each vdata by its reference number then
   * attach to the vdata and search for the fields.  The loop
   * terminates when the last vdata is reached or when a vdata which
   * contains the fields listed in SEARCHED_FIELDS is found.
   */
   while ((vdata_ref = VSgetid (file_id, vdata_ref)) != FAIL)
   {
      vdata_id = VSattach (file_id, vdata_ref, "r");
      if ((status_n = VSfexist (vdata_id, SEARCHED_FIELDS)) != FAIL)
      {
         found_fields = TRUE;
         break;
      }
```

```
         /*
         * Detach from the current vdata before continuing searching.
         */
         status_32 = VSdetach (vdata_id);

         index++;/* advance the index by 1 for the next vdata */
      }

      /*
      * Print the index of the vdata containing the fields or a "not found"
      * message if no such vdata is found.  Also detach from the vdata found.
      */
      if (!found_fields)
         printf ("Fields Position and Temperature were not found.\n");
      else
      {
         printf
        ("Fields Position and Temperature found in the vdata at position %d\n",
          index);
         status_32 = VSdetach (vdata_id);
      }

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

FORTRAN:

```
      program locate_vdata
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      character*20 SEARCHED_FIELDS
C
      parameter (FILE_NAME       = 'General_Vdatas.hdf',
     +           SEARCHED_FIELDS = 'Position,Temperature')
      integer DFACC_READ
      parameter (DFACC_READ = 1)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsfgid, vsfex, vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer status
      integer file_id, vdata_id, vdata_ref
      integer index
      logical found_fields
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 VS interface.
C
      status = vfstart(file_id)
      index = 0
C
C     Set the reference number to -1 to start the search from the beginning
C     of the file.
C
      vdata_ref = -1
C
C     Assume that the specified fields are not found in the current vdata.
C
      found_fields = .FALSE.
10    continue
C
C     Use vsfgid to obtain each vdata by its reference number then
C     attach to the vdata and search for the fields. The loop terminates
C     when the last vdata is reached or when a vdata which contains the
C     fields listed in SEARCHED_FIELDS is found.
C
      vdata_ref = vsfgid(file_id, vdata_ref)
      if (vdata_ref .eq. -1) goto 100
      vdata_id = vsfatch(file_id, vdata_ref, 'r')
      status = vsfex(vdata_id, SEARCHED_FIELDS)
      if (status .ne. -1) then
          found_fields = .TRUE.
          goto 100
      endif
      status = vsfdtch(vdata_id)
      index = index + 1
      goto 10
100   continue
C
C     Print the index of the vdata containing the fields or a 'not found'
C     message if no such vdata is found. Also detach from the vdata found.
C
      if(.NOT.found_fields) then
         write(*,*) 'Fields Positions and Temperature were not found'
      else
         write(*,*)
     +   'Fields Positions and Temperature were found in the vdata',
     +   ' at position ', index
C
C        Terminate access to the vdata
C
         status = vsfdtch(vdata_id)
      endif
C
C     Terminate access to the VS interface and close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.8 Vdata Attributes

HDF version 4.1r1 and later include the ability to assign attributes to a vdata and/or a vdata field. 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 integer cannot be added to an attribute value consisting of ten characters, or a character value cannot be included in an attribute value consisting of 2 32-bit integers.

Any number of attributes can be assigned to either a vdata or any single field in a vdata. However, each attribute name should be unique within its scope. In other words, the name of a field's attribute must be unique among all attributes that belong to that same field, and the name of a vdata's attribute must be unique among all attributes assigned to the same vdata.

The following subsections describe routines that retrieve various information about vdata and vdata field attributes. Those routines that access field attributes require the field index as a parameter (`field_index`).

4.8.1 Querying the Index of a Vdata Field Given the Field Name: VSfindex

VSfindex retrieves the index of a field given its name, `field_name`, and stores the value in the parameter `field_index`. The syntax of **VSfindex** is as follows:

```
C:        status = VSfindex(vdata_id, field_name, &field_index);

FORTRAN:  status = vsffidx(vdata_id, field_name, field_index)
```

The parameter `field_index` is the index number that uniquely identifies the location of the field within the vdata. Field index numbers are assigned in increasing order and are zero-based: for example, a `field_index` value of 4 would refer to the fifth field in the vdata.

VSfindex returns `SUCCEED` (or `0`) if successful and `FAIL` (or `-1`) otherwise. The parameters for **VSfindex** are further defined in Table 4J.

TABLE 4J **VSfindex Parameter List**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSfindex [intn] **(vsffidx)**	vdata_id	int32	integer	Vdata identifier
	field_name	char *	character*(*)	Name of the vdata field
	field_index	int32 *	integer	Index of the vdata field

4.8.2 Setting the Attribute of a Vdata or Vdata Field: VSsetattr

VSsetattr attaches an attribute to a vdata or a vdata field. The syntax of **VSsetattr** is as follows:

```
C:        status = VSsetattr(vdata_id, field_index, attr_name, data_type,
                          n_values, values);

FORTRAN:  status = vsfsnat(vdata_id, field_index, attr_name, data_type,
                          n_values, values)

    OR    status = vsfscat(vdata_id, field_index, attr_name, data_type,
                          n_values, values)
```

If the attribute has already been attached, the new attribute values will replace the current values, provided the data type and the number of attribute values (n_values) have not been changed. If either of these have been changed, **VSsetattr** will return FAIL (or -1).

Set the parameter field_index to _HDF_VDATA (or -1) to set an attribute for a vdata or to a valid field index to set attribute for a vdata field. A valid field index is a zero-based integer value representing the ordinal location of a field within the vdata.

The parameter attr_name specifies the name of the attribute to be set and can contain VSNAMELENMAX (or 64) characters. The parameter data_type specifies the data type of the attribute values. Data types supported by HDF are listed in Table 2E on page 14. The parameter values contains attribute values to be written.

The FORTRAN-77 version of **VSsetattr** has two routines: **vsfsnat** sets numeric attribute data and **vsfscat** sets character attribute data.

VSsetattr returns SUCCEED (or 0) if successful and FAIL (or -1) otherwise. The parameters for **VSsetattr** are described in Table 4K.

4.8.3 Querying the Values of a Vdata or Vdata Field Attribute: VSgetattr

VSgetattr returns all of the values of the specified attribute of the specified vdata field or vdata. The syntax of **VSgetattr** is as follows:

```
C:          status = VSgetattr(vdata_id, field_index, attr_index, values);

FORTRAN:    status = vsfgnat(vdata_id, field_index, attr_index, values)
    OR      status = vsfgcat(vdata_id, field_index, attr_index, values)
```

Set the parameter field_index to _HDF_VDATA (or -1) to retrieve the values of the attribute attached to the vdata identified by the parameter vdata_id. Set field_index to a zero-based integer value to retrieve the values of an attribute attached to a vdata field; the value of field_index will be used as the index of the vdata field. In both cases, the values returned will be those of the attribute located at the position specified by the parameter attr_index, the zero-based index of the target attribute.

The parameter values must be sufficiently allocated to hold the retrieved attribute values. Use **VSattrinfo** to obtain information about the attribute values for appropriate memory allocation.

The FORTRAN-77 versions of **VSgetattr** has two routines: **vsfgnat** gets numeric attribute data and **vsfgcat** gets character attribute data.

VSgetattr returns SUCCEED (or 0) if successful and FAIL (or -1) otherwise. The parameters for **VSgetattr** are described in Table 4K.

TABLE 4K **VSsetattr and VSgetattr Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSsetattr [intn] **(vsfsnat/vsfscat)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	_HDF_VDATA or index of the field
	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
	values	VOIDP	<valid numeric data type>(*)/ character*(*)	Buffer containing the attribute values
VSgetattr [intn] **(vsfgnat/vsfgcat)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	_HDF_VDATA or index of the field
	attr_index	intn	integer	Index of the attribute
	values	VOIDP	<valid numeric data type>(*)/ character*(*)	Buffer containing attribute values

4.8.4 Querying the Total Number of Vdata and Vdata Field Attributes: VSnattrs

VSnattrs returns the total number of attributes of the specified vdata *and* the fields contained in the vdata. This is different from the **VSfnattrs** routine, which returns the number of attributes of the specified vdata *or* a specified field contained in the specified vdata. The syntax of **VSnattrs** is as follows:

```
C:        num_of_attrs = VSnattrs(vdata_id);

FORTRAN:  num_of_attrs = vsfnats(vdata_id)
```

VSnattrs returns the total number of attributes assigned to the vdata and its fields when successful, and FAIL (or -1) otherwise. The parameters for **VSnattrs** are described in Table 4L.

4.8.5 Querying the Number of Attributes of a Vdata or a Vdata Field: VSfnattrs

VSfnattrs returns the number of attributes attached to the vdata field specified by the parameter field_index *or* the number of attributes attached to the vdata identified by vdata_id. This is different from the routine **VSnattrs**, which returns the total number of attributes of the specified vdata *and* the fields contained in it. The syntax of **VSfnattrs** is as follows:

```
C:        num_of_attrs = VSfnattrs(vdata_id, field_index);

FORTRAN:  num_of_attrs = vsffnas(vdata_id, field_index)
```

If field_index is set to a zero-based integer value, it will be used as the index of the vdata field, and the number of attributes attached to that field will be returned. If field_index is set to _HDF_VDATA (or -1), the number of attributes attached to the vdata specified by vdata_id will be returned.

VSfnattrs returns the number of attributes assigned to the specified vdata or to the specified vdata field when successful, and FAIL (or -1) otherwise. The parameters for **VSfnattrs** are described in Table 4L.

TABLE 4L **VSnattrs and VSfnattrs Parameter Lists**

Routine Name [Return Type] (FORTRAN-77)	Parameter	Parameter Type		Description
		C	FORTRAN-77	
VSnattrs [intn] **(vsfnats)**	vdata_id	int32	integer	Vdata identifier
VSfnattrs [int32] **(vsffnas)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	_HDF_VDATA or index of the field

4.8.6 Retrieving the Index of a Vdata or Vdata Field Attribute Given the Attribute Name: VSfindattr

VSfindattr returns the index of an attribute with the specified name. The attribute must be attached to either a vdata or one of its fields. The syntax of **VSfindattrs** is as follows:

```
C:          attr_index = VSfindattr(vdata_id, field_index, attr_name);

FORTRAN:    attr_index = vsffdat(vdata_id, field_index, attr_name)
```

If `field_index` is set to `_HDF_VDATA` (or `-1`), the index of the attribute identified by the parameter `attr_name` and attached to the vdata specified by `vdata_id` will be returned.

If the parameter `field_index` is set to a zero-based integer value, the value will be used as the index of the vdata field. Then, the index of the attribute named by the parameter `attr_name` and attached to the field specified by the parameter `field_index` will be returned.

VSfindattr returns an attribute index if successful, and `FAIL` (or `-1`) otherwise. The parameters for **VSfindattr** are described in Table 4M on page 174.

4.8.7 Querying Information on a Vdata or Vdata Field Attribute: VSattrinfo

VSattrinfo returns the name, data type, number of values, and the size of the values of the specified attribute of the specified vdata field or vdata. The syntax of **VSattrinfo** is as follows:

```
C:          status = VSattrinfo(vdata_id, field_index, attr_index, attr_name,
                                &data_type, &n_values, &size);

FORTRAN:    status = vsfainf(vdata_id, field_index, attr_index, attr_name,
                                data_type, n_values, size)
```

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

The parameter `field_index` is the same as the parameter `field_index` in **VSsetattr**; it can be set either to a nonnegative integer to specify the field or to `_HDF_VDATA` (or `-1`) to specify the vdata referred to by `vdata_id`.

VSattrinfo returns `SUCCEED` (or `0`) if successful and `FAIL` (or `-1`) otherwise. The parameters for **VSattrinfo** are described in Table 4M.

4.8.8 Determining whether a Vdata Is an Attribute: VSisattr

The HDF library stores vdata attributes and vdata field attributes as vdatas. HDF therefore provides the routine **VSisattr** to determine whether a particular vdata contains attribute data. The syntax of **VSisattr** is as follows:

```
C:          status = VSisattr(vdata_id);

FORTRAN:    status = vsfisat(vdata_id)
```

VSisattr returns `TRUE` (or `1`) if the vdata contains an attribute data and `FALSE` (or `0`) otherwise. The parameters for **VSisattr** are described in Table 4M.

TABLE 4M **VSfindattr, VSattrinfo, and VSisattr Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSfindattr [intn] **(vsffdat)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	`_HDF_VDATA` or index of the field
	attr_name	char *	character*(*)	Name of the attribute
VSattrinfo [intn] **(vsfainf)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Index of the field
	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	Number of values of the attribute
	size	int32 *	integer	Size, in bytes, of the values of the attribute
VSisattr [intn] **(vsfisat)**	vdata_id	int32	integer	Vdata identifier

EXAMPLE 8. **Operations on Field and Vdata Attributes**

This example illustrates the use of **VSsetattr/vsfscat/vsfsnat** to attach an attribute to a vdata and to a field in a vdata, the use of **VSattrinfo/vsfainf** to get information about a field attribute and a vdata attribute, and the use of **VSgetattr/vsfgcat/vsfgnat** to get the values of an attribute of a vdata and the values of an attribute of a field in a vdata. The example also shows the use of **VSfnattrs/vsffnas** to obtain the number of attributes attached to a field of a vdata and the use of **VSnattrs/vsfnats** to obtain the total number of attributes attached to both a vdata and its fields.

In this example, the program finds the vdata, named "Solid Particle", in the HDF file "General_Vdatas.hdf" produced by Example 3. It then obtains the index of the field, named "Mass", in the vdata. An attribute named "Site Ident" is attached to the vdata to contain the identification of the experiment sites. Another attribute named "Scales" is attached to the field for its scale values. The vdata attribute has 3 character values and the field attribute has 4 integer values.

C:

```
#include "hdf.h"

#define  FILE_NAME        "General_Vdatas.hdf"
#define  VDATA_NAME       "Solid Particle"
#define  FIELD_NAME       "Mass"
#define  VATTR_NAME       "Site Ident"      /* name of the vdata attribute  */
#define  FATTR_NAME       "Scales"          /* name of the field attribute  */
```

```
#define  VATTR_N_VALUES   3      /* number of values in the vdata attribute */
#define  FATTR_N_VALUES   4      /* number of values in the field attribute */

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, vdata_ref, vdata_id,
         field_index,   /* index of a field within the vdata */
         n_vdattrs,     /* number of vdata attributes */
         n_fldattrs,    /* number of field attributes */
         vdata_type,    /* to hold the type of vdata’s attribute */
         vdata_n_values,/* to hold the number of vdata’s attribute values   */
         vdata_size,    /* to hold the size of vdata’s attribute values     */
         field_type,    /* to hold the type of field’s attribute            */
         field_n_values,/* to hold the number of field’s attribute values   */
         field_size;    /* to hold the size of field’s attribute values     */
   char  vd_attr[VATTR_N_VALUES] = {’A’, ’B’, ’C’};/* vdata attribute values*/
   int32 fld_attr[FATTR_N_VALUES] = {2, 4, 6, 8};  /* field attribute values*/
   char  vattr_buf[VATTR_N_VALUES];     /* to hold vdata attribute’s values */
   int32 fattr_buf[FATTR_N_VALUES];     /* to hold field attribute’s values */
   char  vattr_name[30],                /* name of vdata attribute */
         fattr_name[30];                /* name of field attribute */

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

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

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

   /*
   * Get the reference number of the vdata named VDATA_NAME.
   */
   vdata_ref = VSfind (file_id, VDATA_NAME);

   /*
   * Attach to the vdata for writing.
   */
   vdata_id = VSattach (file_id, vdata_ref, "w");

   /*
   * Attach an attribute to the vdata, i.e., indicated by the second parameter.
   */
   status_n = VSsetattr (vdata_id, _HDF_VDATA, VATTR_NAME, DFNT_CHAR,
                                                   VATTR_N_VALUES, vd_attr);

   /*
   * Get the index of the field FIELD_NAME within the vdata.
   */
   status_n = VSfindex (vdata_id, FIELD_NAME, &field_index);

   /*
   * Attach an attribute to the field field_index.
   */
   status_n = VSsetattr (vdata_id, field_index, FATTR_NAME, DFNT_INT32,
                                                   FATTR_N_VALUES, fld_attr);

   /*
   * Get the number of attributes attached to the vdata's first
   * field - should be 0.
   */
   n_fldattrs = VSfnattrs (vdata_id, 0);
   printf ( "Number of attributes of the first field of the vdata: %d\n",
             n_fldattrs);

   /*
   * Get the number of attributes attached to the field specified by
   * field_index - should be 1.
   */
   n_fldattrs = VSfnattrs (vdata_id, field_index);
   printf ( "Number of attributes of field %s: %d\n", FIELD_NAME, n_fldattrs);

   /*
   * Get the total number of the field's and vdata's attributes - should be 2.
   */
   n_vdattrs = VSnattrs (vdata_id);
   printf ( "Number of attributes of the vdata and its fields: %d\n",
             n_vdattrs);

   /*
   * Get information about the vdata's first attribute, indicated
   * by the third parameter which is the index of the attribute.
   */
   status_n = VSattrinfo (vdata_id, _HDF_VDATA, 0, vattr_name,
                          &vdata_type, &vdata_n_values, &vdata_size);

   /*
   * Get information about the first attribute of the field specified by
   * field_index.
   */
   status_n = VSattrinfo (vdata_id, field_index, 0, fattr_name, &field_type,
                          &field_n_values, &field_size);

   /*
   * Get the vdata's first attribute.
   */
   status_n = VSgetattr (vdata_id, _HDF_VDATA, 0, vattr_buf);
   printf("Values of the vdata attribute = %c %c %c\n", vattr_buf[0],
                          vattr_buf[1], vattr_buf[2]);

   /*
   * Get the first attribute of the field specified by field_index.
   */
   status_n = VSgetattr (vdata_id, field_index, 0, fattr_buf);
   printf("Values of the field attribute = %d %d %d %d\n", fattr_buf[0],
                          fattr_buf[1], fattr_buf[2], fattr_buf[3]);

   /*
   * Terminate access to the vdata and to the VS interface, then close
   * the HDF file.
   */
   status_32 = VSdetach (vdata_id);
   status_n  = Vend (file_id);
   status_32 = Hclose (file_id);
}
```

FORTRAN:

```
      program vdata_attributes
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      character*14 VDATA_NAME
      character*4  FIELD_NAME
      character*10 VATTR_NAME
      character*6  FATTR_NAME
      integer      VATTR_N_VALUES, FATTR_N_VALUES
C
      parameter (FILE_NAME    = ’General_Vdatas.hdf’,
     +           VDATA_NAME   = ’Solid Particle’,
     +           FIELD_NAME   = ’Mass’,
     +           VATTR_NAME   = ’Site Ident’,
     +           FATTR_NAME   = ’Scales’)
      parameter (VATTR_N_VALUES = 3,
     +           FATTR_N_VALUES = 4)

      integer DFACC_WRITE, FULL_INTERLACE, HDF_VDATA
      integer DFNT_INT32, DFNT_CHAR8
      parameter (DFACC_WRITE    =  2,
     +           FULL_INTERLACE =  0,
     +           HDF_VDATA      = -1,
     +           DFNT_INT32     = 24,
     +           DFNT_CHAR8     =  4)
C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsffnd, vsfatch, vsfscat, vsfsnat,
     +        vsffnas, vsffidx, vsfnats, vsfainf, vsfgcat, vsfgnat,
     +        vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer   status
      integer   file_id, vdata_id, vdata_ref
      integer   field_index, n_vdattrs, n_fldattrs
      integer   vdata_type, vdata_n_values, vdata_size
      integer   field_type, field_n_values, field_size
      character vd_attr(VATTR_N_VALUES)
      integer   fld_attr(FATTR_N_VALUES)
      character vattr_buf(VATTR_N_VALUES)
      integer   fattr_buf(FATTR_N_VALUES)
      character vattr_name_out(30), fattr_name_out(30)
      data vd_attr /’A’, ’B’, ’C’/
      data fld_attr /2, 4, 6, 8/
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 VS interface.
C
      status = vfstart(file_id)
```

```
C
C     Get the reference number of the vdata named VDATA_NAME.
C
      vdata_ref = vsffnd(file_id, VDATA_NAME)
C
C     Attach to the vdata for writing.
C
      vdata_id = vsfatch(file_id, vdata_ref, ’w’)
C
C     Attach an attribute to the vdata, as it is indicated by second parameter.
C
      status = vsfscat(vdata_id, HDF_VDATA, VATTR_NAME, DFNT_CHAR8,
     +                  VATTR_N_VALUES, vd_attr)
C
C     Get the index of the field FIELD_NAME within the vdata.
C
      status = vsffidx(vdata_id, FIELD_NAME, field_index)
C
C     Attach an attribute to the field with the index field_index.
C
      status = vsfsnat(vdata_id, field_index, FATTR_NAME, DFNT_INT32,
     +                  FATTR_N_VALUES, fld_attr)

C
C     Get the number of attributes attached to the vdata’s first
C     field - should be 0.
C
      n_fldattrs = vsffnas(vdata_id, 0)
      write(*,*) ’Number of attributes of the first field’
      write(*,*) ’ of the vdata: ’, n_fldattrs
C
C     Get the number of the attributes attached to the field specified by
C     index field_index - should be 1.
C
      n_fldattrs = vsffnas(vdata_id, field_index)
      write(*,*) ’Number of attributes of field ’, FIELD_NAME,
     +           n_fldattrs
C
C     Get the total number of the field’s and vdata’s attributes - should be 2.
C
      n_vdattrs = vsfnats(vdata_id)
      write(*,*) ’Number of attributes of the vdata and its fields: ’,
     +           n_vdattrs
C
C     Get information about the vdata’s first attribute, indicated by
C     the third parameter, which is the index of the attribute.
C
      status = vsfainf(vdata_id, HDF_VDATA, 0, vattr_name_out,
     +                 vdata_type, vdata_n_values, vdata_size)
C
C     Get information about the first attribute of the field specified by
C     field_index.
C
      status = vsfainf(vdata_id, field_index, 0, fattr_name_out,
     +                 field_type, field_n_values, field_size)
C
C     Get the vdata’s first attribute.
C
      status = vsfgcat(vdata_id, HDF_VDATA, 0, vattr_buf)
      write(*,*) ’Values of vdata attribute  ’, vattr_buf
C
C     Get the first attribute of the field specified by field_index.
C
```

```
      status = vsfgnat(vdata_id, field_index, 0, fattr_buf)
      write(*,*)  'Values of the field attribute = ', fattr_buf
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.9 Obtaining Information about a Specific Vdata

Once a vdata has been located, its contents must be obtained. In this section four categories of routines that obtain vdata information are described:

- A general inquiry routine named **VSinquire**.
- A set of ***vdata query*** routines with names prefaced by "VSQuery".
- A set of ***vdata inquiry*** routines prefaced by "VS". Some of these routines retrieve specific vdata information which can also be retrieved by the general inquiry routine **VSinquire**.
- A set of ***field query*** routines with names prefaced by "VF".

4.9.1 Obtaining Vdata Information: VSinquire

VSinquire retrieves information about the vdata identified by the parameter `vdata_id`. The routine has the following syntax:

```
C:          status = VSinquire(vdata_id, &n_records, &interlace_mode,
                               fieldname_list, &vdata_size, vdata_name);

FORTRAN:    status = vsfinq(vdata_id, n_records, interlace_mode, fieldname_list,
                               vdata_size, vdata_name)
```

The parameter `n_records` contains the returned number of records in the vdata, the parameter `interlace_mode` contains the returned interlace mode of the vdata contents, the parameter `fieldname_list` is a comma-separated list of the returned names of all the fields in the vdata, the parameter `vdata_size` is the returned size, in bytes, of the vdata record, and the parameter `vdata_name` contains the returned name of the vdata.

If any of the parameters are set to `NULL` in C, the corresponding data will not be returned.

VSinquire returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`). The parameters for **VSinquire** are further defined in Table 4N.

TABLE 4N **VSinquire Parameter List**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSinquire [intn] **(vsfinq)**	vdata_id	int32	integer	Vdata identifier
	n_records	int32 *	integer	Number of records in the vdata
	interlace_mode	int32 *	integer	Interlace mode
	fieldname_list	char *	character*(*)	Buffer for the list of field names
	vdata_size	int32 *	integer	Size in bytes of the vdata record
	vdata_name	char *	character*(*)	Name of the vdata

EXAMPLE 9.

Obtaining Vdata Information

This example illustrates the use of **VSgetid/vsfgid** and **VSinquire/vsfinq** to obtain information about all vdatas in an HDF file.

In this example, the program uses **VSgetid** to locate all vdatas in the HDF file "General_Vdatas.hdf", which is the output of Example 3. For each vdata found, if it is not the storage of an attribute, the program uses **VSinquire/vsfinq** to obtain information about the vdata and displays its information. Recall that an attribute is also stored as a vdata; the function **VSisattr/vsfisat** checks whether a vdata is a storage of an attribute.

C:

```
#include "hdf.h"

#define  FILE_NAME      "General_Vdatas.hdf"
#define  FIELD_SIZE     80         /* maximum length of all the field names */

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

   intn  status_n;      /* returned status for functions returning an intn  */
   int32 status_32,     /* returned status for functions returning an int32 */
         n_records,     /* to retrieve the number of records in the vdata   */
         interlace_mode,/* to retrieve the interlace mode of the vdata      */
         vdata_size,    /* to retrieve the size of all specified fields     */
         file_id, vdata_ref, vdata_id;
   char  fieldname_list[FIELD_SIZE], /* buffer to retrieve the vdata data   */
         vdata_name[VSNAMELENMAX];   /* buffer to retrieve the vdata name   */

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

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

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

   /*
   * Set vdata_ref to -1 to start the search from the beginning of file.
   */
   vdata_ref = -1;

   /*
   * Use VSgetid to obtain each vdata by its reference number then attach
   * to the vdata and get its information.  The loop terminates when
   * the last vdata is reached.
   */
   while ((vdata_ref = VSgetid (file_id, vdata_ref)) != FAIL)
   {
      /*
      * Attach to the current vdata for reading.
      */
      vdata_id = VSattach (file_id, vdata_ref, "r");

      /*
      * Test whether the current vdata is not a storage of an attribute, then
      * obtain and display its information.
      */
      if( VSisattr (vdata_id) != TRUE )
      {
         status_n = VSinquire (vdata_id, &n_records, &interlace_mode,
                            fieldname_list, &vdata_size, vdata_name);
         printf ("Vdata %s: - contains %d records\n\tInterlace mode: %s \
                 \n\tFields: %s - %d bytes\n\t\n", vdata_name, n_records,
                 interlace_mode == FULL_INTERLACE ? "FULL" : "NONE",
                 fieldname_list, vdata_size );
      }

      /*
      * Detach from the current vdata.
      */
      status_32 = VSdetach (vdata_id);
   } /* while */

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

FORTRAN:

```
      program vdata_info
      implicit none
C
C     Parameter declaration
C
      character*18 FILE_NAME
      integer      DFACC_READ, FULL_INTERLACE
      integer      FIELD_SIZE
C
      parameter (FILE_NAME      = ’General_Vdatas.hdf’,
     +           DFACC_READ     = 1,
     +           FULL_INTERLACE = 0,
     +           FIELD_SIZE     = 80)

C
C     Function declaration
C
      integer hopen, hclose
      integer vfstart, vsfatch, vsfgid, vsfinq,
     +        vsfisat, vsfdtch, vfend

C
C**** Variable declaration *******************************************
C
      integer      status
      integer      file_id, vdata_id, vdata_ref
      integer      n_records, interlace_mode, vdata_size
      character*64 vdata_name
      character*80 fieldname_list
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 VS interface.
C
      status = vfstart(file_id)
C
C     Set the reference number to -1 to start the search from the beginning
C     of the file.
C
      vdata_ref = -1
10    continue
C
C     Use vsfgid to obtain each vdata by its reference number then
C     attach to the vdata and get information. The loop terminates
C     when the last vdata is reached.
C
      vdata_ref = vsfgid(file_id, vdata_ref)
      if (vdata_ref .eq. -1) goto 100
C
C     Attach to the current vdata for reading.
C
      vdata_id = vsfatch(file_id, vdata_ref, ’r’)
C
C     Test whether the current vdata is not a storage for an attribute,
C     then obtain and display its information.
      if (vsfisat(vdata_id) .ne. 1) then
          status = vsfinq(vdata_id, n_records, interlace_mode,
     +                    fieldname_list, vdata_size, vdata_name)
          write(*,*) ’Vdata: ’, vdata_name
          write(*,*) ’contains ’, n_records, ’ records’
          if (interlace_mode .eq. 0) then
              write(*,*) ’Interlace mode: FULL’
          else
              write(*,*) ’Interlace mode: NONE’
          endif
          write(*,*) ’Fields: ’, fieldname_list(1:30)
          write(*,*) ’Vdata record size in bytes :’, vdata_size
          write(*,*)
      endif
C
C     Detach from the current vdata.
C
      status = vsfdtch(vdata_id)
      goto 10
100   continue
C
C     Terminate access to the vdata and to the VS interface, and
C     close the HDF file.
C
      status = vsfdtch(vdata_id)
      status = vfend(file_id)
      status = hclose(file_id)
      end
```

4.9.2 VSQuery Vdata Information Retrieval Routines

The syntax of the VSQuery routines are as follows:

```
C:          status = VSQueryname(vdata_id, vdata_name);
            status = VSQueryfields(vdata_id, fields);
            status = VSQueryinterlace(vdata_id, &interlace_mode);
            status = VSQuerycount(vdata_id, &n_records);
```

```
           vdata_tag = VSQuerytag(vdata_id);
           vdata_ref = VSQueryref(vdata_id);
           status = VSQueryvsize(vdata_id, &vdata_vsize);

FORTRAN:   status = vsqfname(vdata_id, vdata_name)
           status = vsqfflds(vdata_id, fields)
           status = vsqfintr(vdata_id, interlace_mode)
           status = vsqfnelt(vdata_id, n_records)
           vdata_tag = vsqtag(vdata_id)
           vdata_ref = vsqref(vdata_id)
           status = vsqfvsiz(vdata_id, vdata_vsize)
```

All VSQuery routines except **VSQuerytag** and **VSQueryref** have two arguments. The first argument identifies the vdata to be queried. The second argument is the type of vdata information being requested.

- **VSQueryname** retrieves the name of the specified vdata.
- **VSQueryfields** retrieves the names of the fields in the specified vdata.
- **VSQueryinterlace** retrieves the interlace mode of the specified vdata.
- **VSQuerycount** retrieves the number of records in the specified vdata.
- **VSQuerytag** returns the tag of the specified vdata.
- **VSQueryref** returns the reference number of the specified vdata.
- **VSQueryvsize** retrieves the size, in bytes, of a record in the specified vdata.

VSQuerytag and **VSQueryref** return the tag and reference number, respectively, or FAIL (or -1). All other routines return SUCCEED (or 0) or FAIL (or -1). The parameters for these routines are listed in Table 4O.

TABLE 4O

VSQuery Routines Parameter Lists

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VSQueryname [intn] **(vsqfname)**	vdata_id	int32	integer	Vdata identifier
	vdata_name	char *	character*(*)	Name of the vdata
VSQueryfields [intn] **(vsqfflds)**	vdata_id	int32	integer	Vdata identifier
	fields	char *	character*(*)	Comma-separated list of the field names in the vdata
VSQueryinterlace [intn] **(vsqfintr)**	vdata_id	int32	integer	Vdata identifier
	interlace_mode	int32 *	integer	Interlace mode
VSQuerycount [intn] **(vsqfnelt)**	vdata_id	int32	integer	Vdata identifier
	n_records	int32 *	integer	Number of records in the vdata
VSQueryvsize [intn] **(vsqfvsiz)**	vdata_id	int32	integer	Vdata identifier
	vdata_size	int32 *	integer	Size in bytes of the vdata record
VSQuerytag [int32] **(vsqtag)**	vdata_id	int32	integer	Vdata identifier
VSQueryref [int32] **(vsqref)**	vdata_id	int32	integer	Vdata identifier

4.9.3 Other Vdata Information Retrieval Routines

The routines described in this section, with names prefaced by "VS", are used to obtain specific types of vdata information. The syntax of these routines are as follows:

```
C:        num_of_records = VSelts(vdata_id);
          num_of_fields = VSgetfields(vdata_id, fieldname_list);
          interlace_mode = VSgetinterlace(vdata_id);
          size_of_fields = VSsizeof(vdata_id, fieldname_list);
          status = VSgetname(vdata_id, vdata_name);
          status = VSgetclass(vdata_id, vdata_class);

FORTRAN:  num_of_records = vsfelts(vdata_id)
          num_of_fields = vsfgfld(vdata_id, fieldname_list)
          interlace_mode = vsfgint(vdata_id)
          size_of_fields = vsfsiz(vdata_id, fieldname_list)
          status = vsfgnam(vdata_id, vdata_name)
          status = vsfcls(vdata_id, vdata_class)
```

With the exception of **VSgetclass**, the information obtained through these routines can also be obtained through **VSinquire**. **VSinquire** provides a way to query commonly used vdata information with one routine call. The VS routines in this section are useful in situations where the HDF programmer wishes to obtain only specific information.

- **VSelts** returns the number of records in the specified vdata or `FAIL` (or `-1`).
- **VSgetfields** retrieves the names of all the fields in the specified vdata and returns the number of retrieved fields or `FAIL` (or `-1`).
- **VSgetinterlace** returns the interlace mode of the specified vdata or `FAIL` (or `-1`).
- **VSsizeof** returns the size, in bytes, of the specified fields or `FAIL` (or `-1`).
- **VSgetname** retrieves the name of the specified vdata and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`).
- **VSgetclass** retrieves the class of the specified vdata and returns either `SUCCEED` (or `0`) or `FAIL` (or `-1`).

The parameters for these routines are described in Table 4P.

TABLE 4P **VSelts, VSgetfields, VSgetinterlace, VSsizeof, VSgetname, and VSgetclass Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN -77**	
VSelts [int32] **(vsfelts)**	vdata_id	int32	integer	Vdata identifier
VSgetfields [int32] **(vsfgfld)**	vdata_id	int32	integer	Vdata identifier
	fieldname_list	char *	character*(*)	List of field names to be queried
VSgetinterlace [int32] **(vsfgint)**	vdata_id	int32	integer	Vdata identifier
VSsizeof [int32] **(vsfsiz)**	vdata_id	int32	integer	Vdata identifier
	fieldname_list	char *	character*(*)	List of field names to be queried
VSgetname [int32] **(vsfgnam)**	vdata_id	int32	integer	Vdata identifier
	vdata_name	char *	character*(*)	Vdata name

VSgetclass [int32] **(vsfcls)**	vdata_id	int32	integer	Vdata identifier
	vdata_class	char *	character*(*)	Class name of the vdata to be queried

4.9.4 VF Field Information Retrieval Routines

Routines whose names are prefaced by “VF” are used for obtaining information about specific fields in a vdata. The syntax of these routines are as follows:

```
C:          field_name = VFfieldname(vdata_id, field_index);
            field_file_size = VFfieldesize(vdata_id, field_index);
            field_mem_size = VFfieldisize(vdata_id, field_index);
            num_of_fields = VFnfields(vdata_id);
            field_order = VFfieldorder(vdata_id, field_index);
            field_type = VFfieldtype(vdata_id, field_index);

FORTRAN:    field_name = vffname(vdata_id, field_index)
            field_file_size = vffesiz(vdata_id, field_index)
            field_mem_size = vffisiz(vdata_id, field_index)
            num_of_fields = vfnflds(vdata_id)
            field_order = vffordr(vdata_id, field_index)
            field_type = vfftype(vdata_id, field_index)
```

The functionality of each of the VF routines is as follows:

- **VFfieldname** returns the name of the specified field.
- **VFfieldesize** returns the size of the specified field as stored in the HDF file. This is the size of the field as tracked by the HDF library.
- **VFfieldisize** returns the size of the specified field as stored in memory. This is the native machine size of the field.
- **VFnfields** returns the number of fields in the specified vdata.
- **VFfieldorder** returns the order of the specified field.
- **VFfieldtype** returns the data type of the specified field.

If the operations are unsuccessful, these routines return `FAIL` (or `-1`). The parameters for all of these routines are described in Table 4Q.

TABLE 4Q **VF Routines Parameter Lists**

Routine Name [Return Type] **(FORTRAN-77)**	**Parameter**	**Parameter Type**		**Description**
		C	**FORTRAN-77**	
VFfieldname **[char *]** **(vffname)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Field index
VFfieldesize [int32] **(vffesiz)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Field index
VFfieldisize [int32] **(vffisiz)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Field index
VFnfields [int32] **(vfnflds)**	vdata_id	int32	integer	Vdata identifier

VFfieldorder [int32] **(vffordr)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Field index
VFfieldtype [int32] **(vfftype)**	vdata_id	int32	integer	Vdata identifier
	field_index	int32	integer	Field index