

# **Aspen HYSYS**

## ***Customization Guide***

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# 1 Introduction

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# 1.1 Customization

Unlike its accompanying volumes, the Customization Guide does not discuss exact procedures for accomplishing tasks within HYSYS. The purpose of this volume is to demonstrate the possible simulation technologies that can be created both within HYSYS and also in addition to the application. HYSYS incorporates an advanced software architecture and OLE Technology to provide a component-based framework that can be easily customized, updated and maintained to meet changing user requirements.

The term customization encompasses several different approaches for tailoring HYSYS including:

| Method               | Description   |
|----------------------|---|
| <b>Automation</b>    | The use of third party tools such as Visual Basic or the HYSYS Macro Language Editor to programmatically run HYSYS.   |
| <b>Extensibility</b> | The creation of custom unit operations, property packages and kinetic reactions which become part of the simulation and function as built in HYSYS objects. |

The difference between automation and extensibility may not be explicitly apparent. The difference lies in the environment in which your personal algorithms are executed. Automation requires the use of third party software to link to HYSYS in a client-server relationship. Using this functionality, you can hide the complexity of a simulation by building a front-end in another program that allows access to only the important parameters of the simulation. You can also use HYSYS as a server in your own applications. HYSYS is an Automation Server, which means that it can act as an Automation client that can be used to access HYSYS. Some examples of tools that can access HYSYS are Microsoft Visual Basic and the VBA component of applications such as Excel, Word, PowerPoint and Visio. You can also access HYSYS through programs written in C++.

Extensibility incorporates your custom algorithms in the form of Extension Property Packages, Extension Unit Operations, and Extension Reaction Kinetics. The calculations take place within the calculation sequence of a HYSYS simulation. Extensions can

be easily distributed to other machines, and they appear as any other HYSYS object in the program. You could easily develop an extension, test it, market it and sell it to other HYSYS users as a third party add-in.

The Customization Guide's purpose is threefold:

- To introduce the user to the functionality of HYSYS automation and extensibility.
- To demonstrate different methods of accessing and using HYSYS objects.
- To provide straightforward examples that teach you the basics and allow you to begin customizing HYSYS.

Within the HYSYS environment, several tools are provided so you can begin writing code for automation and extensions:

| Tool                                       | Description   |
|--|---|
| The Macro Language Editor                  | An interactive design environment for developing, testing and executing WinWrap basic scripts.      |
| User Variables and the User Unit Operation | Allow you to increase the functionality of HYSYS by creating your own variables or unit operations. |

For more information on User Variables and User Unit Ops see [Chapter 5 - User Variables](#) and [Chapter 6 - User Unit Operation](#).

## 1.2 Automation & Extensibility

### 1.2.1 Automation

Automation allows programmers to expose objects within a program for use by other applications. The exposed objects provide the means by which different applications can interact with each other and the operating system. Automation is a standard based on Microsoft's Component Object Model (COM). It is not necessary to understand all the intricacies of Automation or COM in order to utilize the functionality they provide.

Automation evolved from what was once called OLE, which stands for Object Linking and Embedding. This allowed you to take a particular object such as a spreadsheet and embed it into

another object such as a text document. Changes to values in the spreadsheet would automatically be updated in the text document. This was a very powerful feature and was available to users without the added complexity of writing code. It was simply a matter of cutting and pasting the objects.

Automation is the ability to programmatically interact with an application through objects exposed by developers of that application. While HYSYS was being developed, code was added to expose various objects in the program. By using an Automation client like Visual Basic, the end user can write the code to access these objects and interact with HYSYS. The end user does not need to see the HYSYS source code or even understand what was required to expose the objects. All that is required is the knowledge of those objects that are available.

Automation works in a client/server fashion. A server is something that provides a service that can be used by clients if they know the proper protocols. HYSYS is an Automation server application. By writing a little Visual Basic code, it is possible to send and receive information to and from HYSYS. The exposed objects make it possible to perform nearly any action that is accomplished through the HYSYS graphical user interface.

You can use Automation to access COMThermo in HYSYS to calculate COMThermo properties such as fugacity coefficients, K-values, entropy, and enthalpy

## 1.2.2 Extensions

The HYSYS architecture allows direct extensibility for unit operations, kinetic reactions, and property packages. Extensibility can be described as the ability to augment existing functionality in a direct and seamless manner. Unit operation extensions look and feel like the existing operations in HYSYS but the algorithms used by the extension reside in a separate Windows DLL. Similarly, kinetic reaction extensions and property package extensions appear seamlessly in the basis environment.

A HYSYS extension is typically composed of two distinct and interdependent components; an ActiveX Server DLL and an Extension Definition File (EDF). The ActiveX Server DLL contains the actual code for the extensions and can be created in any OLE controller language such as Visual Basic, C++, or Delphi. Nearly any other type of compiled code base can be accessed via a short wrapper utilizing Visual Basic or C++. The Server is a program that exposes a class with a set of properties and methods. For HYSYS extensions, the exposed class contains methods recognized by HYSYS (for example, when dealing with a Unit Operation Extension, HYSYS looks for a method named *Initialize* that takes one argument and returns a long variable).

The EDF file acts as the interface view within HYSYS as well as the point for variable declaration and storage. It is created through the Extension View Editor which is included with your copy of HYSYS. The View Editor is similar to the tool used by AspenTech Developers when creating the property views for HYSYS.

## How Does a Hysys Extension Work?

When HYSYS first starts up, it looks in the system registry, at a specific location, to see if any extensions exist for the machine. If an extension does exist it is added to the appropriate menu within HYSYS. Unit operation extensions show up in the UnitOps property view when the Extensions radio button is selected. Kinetic reaction extensions show up in the Reactions property view which is brought up when the **Add Rxn** button is clicked on the **Reactions** tab of the Simulation Basis Manager property view. Property package extensions show up in the Property Package Selection group found on the Set Up tab of the Fluid Package property view.

Once you find the appropriate extension, you can select it and begin using it as though it were a built-in HYSYS object.

## 1.3 Customizing HYSYS

HYSYS can be programmatically run from any tool that supports Automation. You can set up scripts that do repetitive tasks, or you can set up programs of your own that uses HYSYS as the calculation engine.

For example, the simulation of a plant can be easily hidden by a front-end created in Microsoft Excel. This front-end could be a yield prediction program of some sort that uses a rigorous simulation underneath. Another example would be a proprietary equipment sizing program that uses HYSYS to generate fluid properties for the calculations.

When creating these programs, HYSYS can be run invisibly. You do not need to know the source of the calculations, nor do you need to deal with another program on the desktop.

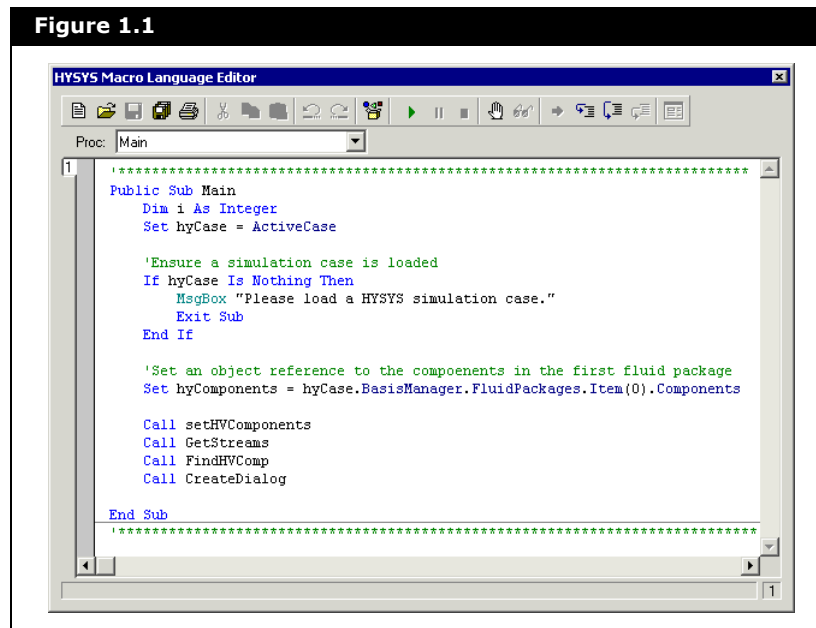
Third party tools are not required to access the automation capabilities of HYSYS. HYSYS provides an Internal Macro Engine that supports the same syntax as Microsoft Visual Basic. With this engine, you can automate tasks in HYSYS without the need for another program.

## 1.3.1 HYSYS & the Macro Language Editor

For more information on the Macro Language Editor, consult the online help that accompanies the editor. You can find the online help in the Help menu in the Editor's menu bar.

The Macro Language Editor is accessed by selecting the **Macro Language Editor** command from the **Tools** menu in the Simulation environment.

**Figure 1.1**



The editor is an interactive design environment for developing, testing and executing WinWrap Basic automation scripts. The editor, which uses a syntax that is very similar to Microsoft®'s Visual Basic, allows you to write code that interacts with HYSYS.

Two objects can be accessed directly from any point in a macro:

- Application
- ActiveCase

These special commands allow you to generalize your macros so that they can be run under many different situations. If you reference the **ActiveCase** object, your macro works for any Simulation Case that is currently open in the HYSYS environment.

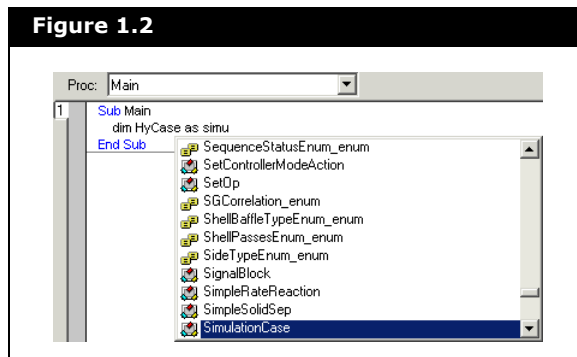


The Macro Language Editor now has two new features:

- Autocompletion feature, which helps you complete the user variable codes and helps you debug the program with flyby evaluation.

For example, if you want to specify "SimulationCase", you just need to type up the first few letters of the variable, and the autocompletion feature will display all variables with similar names in a drop-down list.

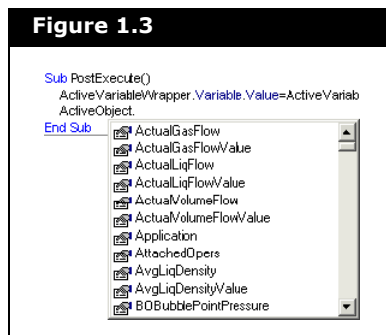
**Figure 1.2**



- List command feature, which shows you a list of valid methods or properties depending on the context (type of expression) you enter.

For example, if you type **ActiveObject** and type the period, a drop-down list appears displaying a list of methods that are applicable to the current object.

**Figure 1.3**



## 1.3.2 Programming HYSYS from External Programs

HYSYS can be accessed from external programs using Automation. Programs such as Microsoft Visual Basic and Microsoft Excel can use HYSYS as a calculation engine, allowing you to create new applications that invisibly use HYSYS in the background.

Two HYSYS objects can be created by an external program:

- The HYSYS Application object
- The HYSYS SimulationCase object

The Application object can be created using one of the HYSYS.Application ProgIDs. The ProgID determines which version of HYSYS is activated. Simulation Cases can be created using the HYSYS.SimulationCase ProgID, or by calling GetObject and passing the name of a Simulation Case. For example, this is how you would create an Application object and a SimulationCase object from Visual Basic:

```
Dim App as Object
Set App = CreateObject("HYSYS.Application")
Dim HYCASE as Object
Set HYCASE = GetObject("c:\hysys\cases\azeocol.hsc")
```

Once the Application and Case objects have been created, other HYSYS objects can be accessed through them. For example, from the Case's flowsheet object (accessed through the flowsheet property of the Case), you can create new Process Streams and Unit Operations.

## VBA

Microsoft Excel and related products make use of Visual Basic for Applications (VBA). VBA is a high level programming language that is oriented around an object framework and event driven execution. Visual Basic is termed “visual” because most applications are created around a graphical interface and Visual Basic is designed to allow code associated with the interface to be added easily and intuitively.

Event driven programming is quite different from typical structured programming. In a structured program, execution begins at the top of the program and executes for the most part in a sequential manner. When the bottom of the program is reached the application exits and is finished. In event driven programming, the path of execution from the beginning of the program to the end depends almost entirely on how the end user interacts with the application.

Visual Basic for Applications is a large sub-set of the Visual Basic language. It is a macro language that is integrated tightly in to supporting applications. The syntax and functionality is identical to straight Visual Basic.

# 2 Automation

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## 2.1 Introduction

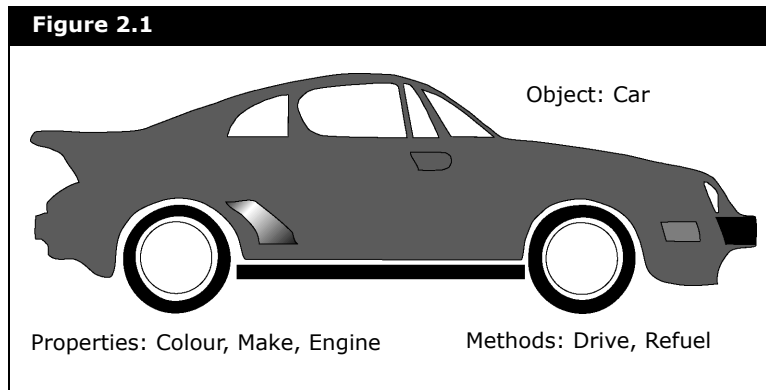
Automation, defined in its simplest terms, is the ability to drive one application from another. For example, the developers of Product A have decided in the design phase that it would make their product more usable if they exposed Product A's objects, thereby making it accessible to Automation. Since Products B, C and D all have the ability to connect to applications that have exposed objects, each can programmatically interact with Product A.

In the early product planning stages, the HYSYS development team had the vision to begin exposing objects. That makes HYSYS a very powerful and useful tool in the design of hybrid solutions. Since access to an application through Automation is language-independent, anyone who can write code in Visual Basic, C++ or Java, to name three languages, can write applications that interact with HYSYS. There are a number of applications that can be used to access HYSYS through Automation, including Microsoft Visual Basic, Microsoft Excel and Visio. With so many combinations of applications that can transfer information, the possibilities are numerous and the potential for innovative solutions is endless.

## 2.2 Objects

The key to understanding Automation lies in the concept of objects. An object is a container that holds a set of related functions and variables. In Automation terminology, the functions of an object are called *methods* and the variables are called *properties*.

Consider the example of a car. If it were an object, a car would have a set of properties such as: make, colour, number of doors, etc. The car object may also have methods such as: turn on, drive or open hood. By utilizing the properties and methods of a car object it is possible to define, manipulate and interact with the object.



Each property of the car is a variable that has a value associated with it. The colour would be a string or hexadecimal number associated with a specific colour. The gas mileage would be single floating point value. Methods are nothing more than functions and sub-routines associated with the object.

An object is a container that holds all the attributes associated with it. An object could contain other objects that are logical sub-set of the main object. The car object may contain other objects such as engine or tire. These objects would have their own set of independent properties and methods. An engine would have properties related to the number of valves and the size of the pistons. The tires would have properties such as tread type or model number.

## 2.2.1 Object Hierarchy

The path that is followed to get to a specific property may involve several objects. The path and structure of objects is referred to as the object hierarchy. In Visual Basic the properties and methods of an object are accessed by hooking together the appropriate objects through a *dot operator* (.) function. Each *dot operator* in the object hierarchy is a function call. In many cases it is beneficial to reduce the number of calls by setting intermediate object variables.

For instance, expanding on our previous example involving the car, suppose there existed an object called **Car** and you wanted to set the value of its engine size. You could approach the problem in one of two ways.

**Direct specification of object property**

```
Car.Engine.Size = 4
```

**Indirect specification of object property**

```
Dim Eng1 as Object  
Set Eng1 = Car.Engine.Size  
Eng1 = 4
```

If the Engine size is a property you wanted to access quite often in your code, using the indirect method of specification may be easier as it reduces the amount of code thereby reducing the possibility of error.

## 2.2.2 HYSYS Type Library

In order to do anything with objects it is first necessary to know what objects are available. When an application is exposed for Automation, a separate file is usually created that lists all the objects and their respective properties and methods. This file is called the type library and nearly all programs that support Automation have one of these files available. With the help of an Object Browser, such as the one built in to MS Excel, you now have a way to view all the objects, properties, and methods in the application by examining the type library.

The HYSYS type library reveals over 340 objects that contain over 5000 combined properties and methods. For every object, the type library shows its associated properties and methods. For every property, the type library shows its return type. For every method, the type library shows what type of arguments are required and what type of value might be returned.

Accessing a specific property or method is accomplished in a hierarchical fashion by following a chain of exposed objects. The first object in the chain should be an object from which all other objects can be accessed. This object is typically the main application or one of the open documents. In HYSYS, the

starting objects are the *SimulationCase* and *Application* objects. All other objects are accessible through these two starting objects.

## 2.2.3 Object Browser

The type library itself does not exist in a form which is immediately viewable to you. In order to view the type library, you require the use of an application commonly referred to as an Object Browser. The Object Browser interprets the type library and displays the relevant information. Microsoft Excel and Visual Basic both include a built in Object Browser.

### Accessing the Object Browser in Excel 97/2000/XP

1. Open the **Tools** menu.
2. Press **ALT F11** (or select the **Visual Basic Editor** option from Macro group).
3. Within the Visual Basic Editor, open the Tools menu.
4. Select the **References** command.
5. Select the checkbox next to the **HYSYS 3.X Type Library**.
6. Click the **OK** button.
7. Open the **View** menu and select the **Object Browser** command (or press **F2**).
8. Open the **Libraries/Workbooks** drop-down list and select **HYSYS**.

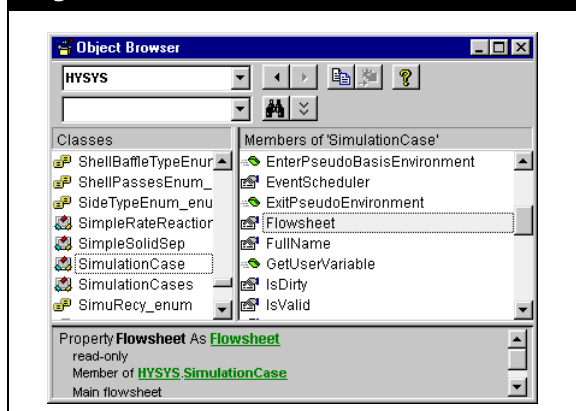


## Navigating Through the type Library

This section shows how to navigate through the type library in order to determine the object hierarchy necessary to access a particular property. Consider the desired property is the temperature of a stream called "Feed\_Stream".

The first step is to begin with one of the starting objects. The Application and SimulationCase objects are the starting points in HYSYS. You can visualize what is available from the Application object by picturing the HYSYS application view when the program is first started. You can do the same with the SimulationCase object by thinking of all the information contained within a case. Nearly all the objects of interest are accessed from the SimulationCase object.

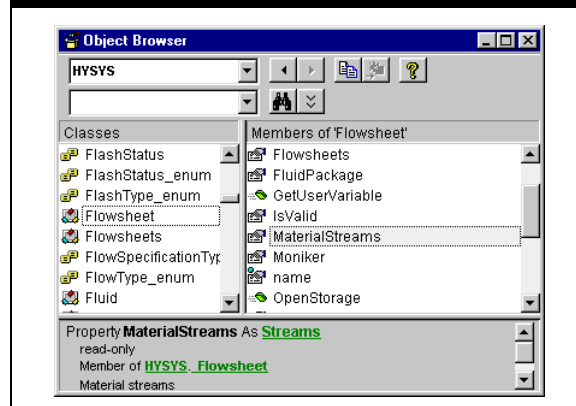
**Figure 2.2**



Selecting the SimulationCase object in the browser reveals all of its related properties and methods. Examining the list of properties does not reveal any type of stream like object so there must be a connection through another object. The properties that are links to other objects can be determined by looking at the type shown when a property is selected. If the type shown is not a string, Boolean, variant, double, integer, or long then it is most likely an object. The object type shown is found somewhere in the object list and is the next step to determining the object hierarchy.

With prior experience in HYSYS the flowsheet object is a logical choice. Selecting the flowsheet object in the object list shows the associated properties and methods. There is an EnergyStreams property, a MaterialStreams property, and a Streams property. All three of these properties are of type Streams and are therefore objects. In this case some previous experience in using HYSYS would suggest that MaterialStreams is the object of interest.

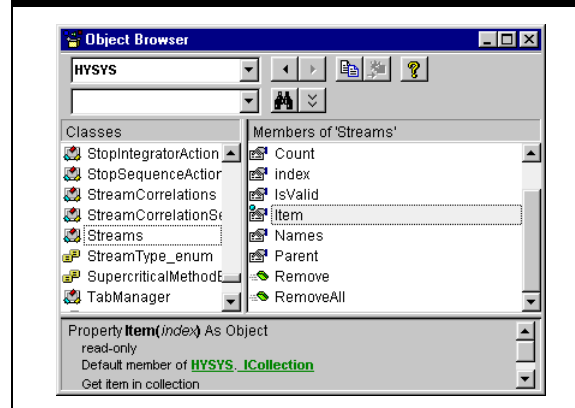
**Figure 2.3**



The MaterialStreams object is of type Streams. Examining the Streams object does not reveal any temperature properties. The Streams object is a collection object, which is simply an object that is a collection of other objects with some properties and methods for navigating through the collection.

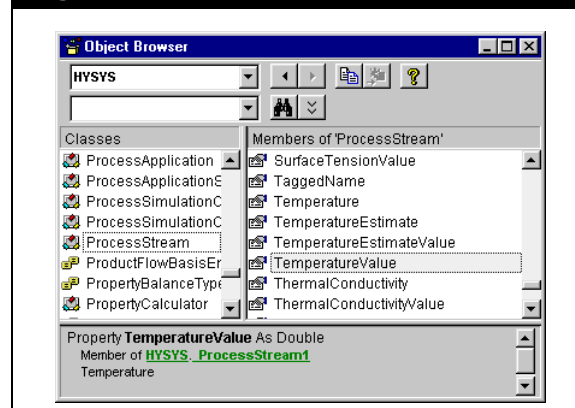
In this case the Streams object is a collection of ProcessStream objects.

**Figure 2.4**



The individual members of a collection object can be accessed by index number (like an array) or directly by name. Either approach can be used through the Item property. Examining the ProcessStream object shows a property called TemperatureValue, which is of type Double. This is the desired property.

**Figure 2.5**



The resulting syntax for the desired property is:

```
SimulationCase.Flowsheet.Streams.  
Item("Feed_Stream").TemperatureValue
```

## 2.3 Automation Syntax

### Declaring Objects

An object in Visual Basic is another type of variable and should be declared. Objects can be declared using the generic type identifier *object*. The preferred method however uses the type library reference to declare the object variables by an explicit object name.

**Early Binding:**

```
Dim|Public|Private objectvar As ObjectName as specified in the type library
```

**Late Binding:**

```
Dim|Public|Private objectvar As Object
```

Once a reference to the type library has been established, the actual name of the object as it appears in the type library can be used. This is called early binding. It offers some advantages over late binding, including speed and access to Microsoft's Intellisense<sup>®</sup> functionality when using Visual Basic or VBA.

**Example: Late Binding**

```
Public hyCase As Object  
Public hyStream As Object
```

**Example: Early Binding**

```
Public hyCase As SimulationCase  
Public hyStream As ProcessStream
```

## Set Keyword

Connections or references to object variables are made by using the *Set* keyword.

**Syntax:**

```
Set objectvar = object.[object...].object | Nothing
```

The example below assumes hycase is set to the SimulationCase object.

**Example: Set**

```
Dim hyStream As ProcessStream  
Set hyStream = hyCase.Flowsheet.MaterialStreams.Item(0)
```

## GetObject, CreateObject

In order to begin communication between the client and server applications, an initial link to the server application must be established. In HYSYS this is accomplished through the starting objects: Application or SimulationCase. The typical ActiveX object structure supplies a starting object to access the application interface and another to access the documents within the application.

**Syntax for creating an instance of an application:**

```
CreateObject(class)
```

```
GetObject([pathname] [, class])
```

where:

*class = the starting object as specified in the type library.  
In HYSYS there are two objects that can be used for the class statement: **HYSYS.Application** or **HYSYS.SimulationCase**.*

The CreateObject function starts a new instance of the main application. CreateObject is used in HYSYS with the

*HYSYS.Application* class as specified in the type library. This connects to the main application interface of HYSYS.

The `GetObject` function opens a specific document in the currently running instance of the server application. If the application is not running then a new instance of the application starts. If a specific document is not specified with the `GetObject` function the current instance of the application is connected or a new instance of the application is started.

For application objects or document objects the codes are shown below:

**Example: CreateObject and GetObject**

```
Set applicationobj = CreateObject("HYSYS.Application")  
or  
Set applicationobj = GetObject(, "PROGRAM.Application")  
Set documentobj = GetObject("c:\filepath", "PROGRAM.Document")
```

In the example below, `hyCase` is declared as type object so it is using late binding. The `hyCase` variable is connected to a HYSYS case by using the `GetObject` function and the `Set` keyword. The second argument in the `GetObject` function is the starting object.

**Example 1: Starting a HYSYS case through Automation**

```
Dim hyCase As Object  
Set hyCase = GetObject("c:\samples\c-2.hsc", "HYSYS.SimulationCase")
```

The second example is identical to the first except that the object variable `hyCase` is declared using the actual object name as it appears in the type library. This assumes that a reference to the type library has already been set.

**Example 2: Starting a HYSYS case through Automation**

```
Dim hyCase As SimulationCase  
Set hyCase = GetObject("c:\samples\c-2.hsc", "HYSYS.SimulationCase")
```

The third example uses early binding in the object declaration. The CreateObject command is used to bring up an instance of HYSYS. The starting object here is the *HYSYS.Application* object since a case is not initially being opened. The SimulationCases object is accessed through the Application object and the Open method of SimulationCases is used to bring up a specific HYSYS case. The hyCase object is set to the active case through the ActiveDocument property of hyApp.

**Example 3: Starting a HYSYS case through Automation**

```
Dim hyCase As SimulationCase
Dim hyApp As HYSYS.Application
Set hyApp = CreateObject("HYSYS.Application")
hyApp.SimulationCases.Open("c:\HYSYS\samples\c-2.hsc")
Set hyCase = hyApp.ActiveDocument
```

## Object Properties, Methods, & Hierarchy

The sequence of objects is set through a special dot function. Properties and methods for an object are also accessed through the *dot function*. It is preferable to keep the sequence of objects to a minimum since each dot function is a call to link between the client and the server application.

**Syntax for setting objects and accessing properties:**

```
Set objectvar = object.[object.object...].object
Variable = object.[object.object...].property
```

**Syntax for accessing methods:**

**Function Method**

```
returnvalue = object.method([argument1, argument2,...])
```

**Sub-routine Method**

```
object.method argument1, argument2
```

The object hierarchy is an important and fundamental concept for utilizing Automation. A particular property can only be accessed by following a specific chain of objects. The chain *always* begins with either the Application or SimulationCase object and ends with the object containing the desired property.

The methods of an object are accessed in the same fashion as properties by utilizing the dot function. A method for a particular object is nothing more than a function or sub-routine whose behaviour is related to the object in some fashion.

Typically the methods of an object require arguments to be passed when the method is called. The type library provides information about which arguments are necessary to call a particular method. A function returns a value.

**Sub-routines in Visual Basic do not require parentheses around the argument list.**

The example below, starts up HYSYS and opens a specific case. The temperature value of a specific stream is then obtained. The temperature value is obtained through a connection of three objects: SimulationCase, Flowsheet, and MaterialStreams.

**Example 1: Accessing HYSYS object properties**

```
Dim hyCase As SimulationCase
Dim TempVal As Double
Set hyCase = GetObject("c:\c-2.hsc", "HYSYS.SimulationCase")
TempVal = hyCase.Flowsheet.MaterialStreams.Item(0).TemperatureValue
MsgBox TempVal
```

The example below, also accesses the temperature value of a specific stream but creates some intermediate objects so that when the temperature value is actually requested the chain of objects only contains one object.

**Example 2: Accessing HYSYS object properties**

```
Dim hyCase As SimulationCase
Dim hyFlowsheet As Flowsheet
Dim hyStream As ProcessStream
Dim TempVal As Double
Set hyCase = GetObject("c:\samples\c-2.hsc", "HYSYS.SimulationCase")
Set hyFlowsheet = hyCase.Flowsheet
Set hyStream = hyCase.Flowsheet.MaterialStreams.Item(0)
TempVal = hyStream.TemperatureValue
MsgBox TempVal
```



## Collection Objects

A collection object is an object that contains a set of other objects. This is similar to an array of objects. The difference between an array of objects and a collection object is that a collection object contains a set of properties and methods for navigating and manipulating the objects in the collection.

### Syntax: Typical Properties of a Collections Object

|                          |   |
|--------------------------|---|
| <code>Item(index)</code> | Accesses a particular member of the collection by number.               |
| <code>Index(name)</code> | Determines the index number for a member in the collection by its name. |
| <code>Count</code>       | Returns the number of objects in the collection.                        |

### Syntax: Enumeration of Objects

```

For Each element In group
    [statements]
    [Exit For]
    [statements]
Next [element]

```

The most commonly used properties are:

- **Index.** The Index property takes in a name and returns a number value associated with the object's name.
- **Item.** The Item property takes an index value or name or integer number as the argument and returns a reference to the object within the collection.
- **Count.** The Count property returns the number of items in the collection.

A special type of *For* loop, called For Each, is available for enumerating through the objects within the collection. The For Each loop provides a means for enumerating through the collection without explicitly specifying how many items are in the collection. This helps avoid having to make additional function calls to the Count and Item properties of the collection object in order to perform the same type of loop.

The example below, connects to a collection of streams by setting the hyStreams object. A For loop is created that uses the Count and Item properties of a collection in order to display a property view that contains the stream name. The items in the collection are indexed beginning with 0. The Count property returns the actual number of objects in the collection so it is necessary to subtract one in order to access all the objects in the collection.

**Example 1: Accessing Collection Objects**

```
Dim hyStreams As Streams
Dim hyStream As ProcessStream
Set hyStreams = hyCase.Flowsheet.MaterialStreams
For j = 0 To hyStreams.Count - 1
    MsgBox hyStreams.Item(j).name
Next j
```

The example below, is identical to the first example except that a For Each loop is used instead of the standard For loop in order to enumerate through the Streams collection.

**Example 2: Accessing Collection Objects**

```
Dim hyStreams As Streams
Dim hyStream As ProcessStream
Set hyStreams = hyCase.Flowsheet.MaterialStreams
For Each hyStream In hyStreams
    MsgBox hyStream.name
Next hyStream
```

## Variants

A property can return a variety of variable types. Values such as temperature and pressure are returned as doubles or 32-bit floating-point values. The stream name property returns a string value. Visual Basic provides an additional variable called a *variant*. A variant is a variable that can take on the form of any type of variable including, Integers, Double, String, Array, and Objects.

If the property of an object returns an array whose size can vary depending upon the case, then a variant is used to access that value. For example, the ComponentMassFractionValue property of a ProcessStream returns an array of doubles sized to the number of components associated with that stream.

In Visual Basic, if a variable is not explicitly declared then it is implicitly a variant. Variants have considerably more storage associated with their use, so for a large application it is good practice to limit the number of variants being used. It is also just good programming practice to explicitly declare variables whenever possible.

The dimensions of the array depend upon what property is being called. The following table lists the most common properties that return arrays and what is the dimension of the array.

| Common Variant of HYSYS          | Returning Property    |
|----------------------------------|-----------------------|
| Component Mass Fractions         | One Dimensional array |
| Column Component Fraction Values | Two Dimensional array |
| Interaction Parameters           | Two Dimensional array |

The example below, shows how to get an array of stage pressures in a column.

#### Example 1: Using Variants in HYSYS

```
Dim hyOp As ColumnOp
Dim hyStagePressure As Variant
Set hyOp = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
hyStagePressure = hyOp.PressureValues
For j = 0 To UBound(hyStagePressure)
    MsgBox "Stage " & j + 1 & " Pressure = " & hyStagePressure(j)
Next j
```

The hyOp object is declared as a ColumnOp as specified in the type library. The operations collection is filtered to only include columns by using the word "ColumnOp". HyOp is set to the first column in the operations collection.

HyStagePressure is set equal to an array of doubles returned by the ColumnOp object. Since the number of stages in this column may not be known the Ubound function is used to

determine the upper bound of the one dimensional array. A property view prints out the pressure value for each stage in the column.

The example below, accesses the VapourComponentFraction property of a column.

**Example 2: Using Variants in HYSYS**

```
Dim hyOp As ColumnOp
Dim hyStageCompFrac As Variant
Set hyOp = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
hyStageCompFrac = hyOp.VapourComponentFraction
For j = 0 To UBound(hyStageCompFrac,2)
    MsgBox "Stage " & j +1 & " Component 1 Vapour Fraction = " &
        hyStageCompFrac(0,j)
Next j
```

The array is set to hyStageCompFrac. This array is two-dimensional. The first dimension represents the components in the systems as specified in the fluid package. The second dimension represents the stages in the column. A property view displays the vapour fraction of component 1 for each stage of the column.

## 2.4 Key HYSYS Objects

### 2.4.1 HYSYS Object Overview

There are over 340 automation objects exposed in HYSYS. These objects collectively contain of over 5000 properties and methods. One of the more time consuming and difficult tasks in learning to use Automation objects is determining what objects are available and how to get at a property of interest.

The following sub-sections are designed to explore key HYSYS objects in more detail and hopefully provide the necessary information required to access nearly any object, property, or method in HYSYS. Because of the large number of key objects and their attributes, the objects within HYSYS have been divided

in seven distinct categories. These object categories are: Container Objects, Support Objects, Oil Objects, Basis Objects, Stream Objects, Operation Objects, Extension Objects, and PFD Objects.

## 2.4.2 Container Objects

This category refers to objects that house other objects or form the basis from which a large number of objects are derived. For instance, the Application object can contain several SimulationCase objects. The SimulationCase object contains all the remaining objects associated with that case. The flowsheet object is a repository for all the streams and unit operations of the case. The flowsheet can also contain another flowsheet, Application or SimulationCase.

### Application and SimulationCase

The Application object is the top most object in HYSYS and represents the HYSYS program itself. From the Application object, nearly all the objects listed in the HYSYS type library can be accessed. The SimulationCase object is the starting object for accessing or opening specific simulation cases.

**Syntax: Connecting to the Application**

```
Set hyApp = CreateObject("HYSYS.Application")
```

**Syntax: Connecting to the Simulation Case****Through GetObject**

```
Set hyCase = GetObject("filepath", "HYSYS.SimulationCase")
```

**Through the Application Object**

```
Set hyCase = hyApp.ActiveDocument
```

**Through SimulationCases Collection Object**

```
Set hyCase = hyApp.SimulationCases.Item("CaseName")
```

## Using GetObject and CreateObject

The SimulationCase object and the Application object can be created directly through the GetObject function in Visual Basic. The CreateObject function can also be used to access the Application object. In general the starting object for most Automation procedures is the SimulationCase object.

The example below, uses the GetObject function to start-up HYSYS with the specified case.

### Example 1: Accessing the HYSYS Container Objects

```
Dim hyCase As SimulationCase
Set hyCase = GetObject("c:\hysys\cases\c-2.hsc", "HYSYS.SimulationCase")
```

The example below, connects to the HYSYS Application object and enumerates through all the currently open cases. If a case name matches the specified string then a SimulationCase object is set to that case. The FOR loop cycles through the list of cases based on the count value. In Visual Basic arrays and collections are base 0 unless otherwise specified.

### Example 2: Accessing the HYSYS Container Objects

```
Dim hyApp As HYSYS.Application
Dim hyCases As SimulationCases
Dim hyCase As SimulationCase
Set hyApp = CreateObject("HYSYS.Application")
Set hyCases = hyApp.SimulationCases
For j = 0 To hycases.Count - 1
    If hycases.Item(j).name = "ethanol.hsc" Then
        Set hyCase = hyCases.Item(j)
    End If
Next j
```

## Starting a Particular Version of HYSYS

To start a particular version of HYSYS via OLE, use one of the following HYSYS.Application ProgIDs.

| ProgID                                      | Description   |
|---|---|
| <b>HYSYS.Application</b>                    | Activates the most currently registered version of HYSYS. For example, if HYSYS 2004.2 is started up after HYSYS 2006 is installed, HYSYS 2004.2 will be activated.<br><b>Note:</b> HYSYS versions 2004.2 and earlier register automatically each time they run.                |
| <b>HYSYS.Application.2006</b>               | Activates HYSYS 2006 as long as it is registered.   |
| <b>HYSYS.Application.Latest</b>             | Activates the latest version of HYSYS that is registered.   |
| <b>HYSYS.Application.3.0</b>                | Activates HYSYS 2004.2 or earlier version, whichever is registered.   |
| <b>HYSYS.Application.NewInstance</b>        | Starts a new instance of the most currently registered version of HYSYS. For example, if HYSYS 2004.2 is started up after HYSYS 2006 is installed, HYSYS 2004.2 will be activated.<br><b>Note:</b> HYSYS versions 2004.2 and earlier register automatically each time they run. |
| <b>HYSYS.Application.NewInstance.2006</b>   | Starts a new instance of HYSYS 2006 as long as it is registered.  |
| <b>HYSYS.Application.NewInstance.Latest</b> | Starts a new instance of the latest version of HYSYS that is registered.  |
| <b>HYSYS.Application.NewInstance3.0</b>     | Starts a new instance of HYSYS 2004.2 or earlier version, whichever is registered.  |

Some ProgIDs activate the most currently registered version of HYSYS. HYSYS versions 2004.2 and earlier register automatically each time they run. However, HYSYS 2006 registers only at installation. You can manually register and un-register HYSYS 2006 using the following commands:

```
HYSYS /regserver
HYSYS /unregserver
```

You can also re-register HYSYS 2006 by selecting the **Restore File Associations** item in the HYSYS 2006 group on the **Start** menu.

If you open a case using GetObject ("casename.hcs"), the case will open with the version of HYSYS that was last registered.

VB6 supports an additional parameter for `GetObject` that allows the case to be open in the version specified. For example, this code would open the case in HYSYS 2006:

```
GetObject ("case.hsc", "HYSYS.SimulationCase.2006")
```

## Flowsheet(s)

The main flowsheet object is accessed through the `SimulationCase` object. The flowsheet object is a container of all the `ProcessStream` and `Operations` objects as well as a link to the `FluidPackage` object associated with that flowsheet. Each flowsheet and sub-flowsheet can have its own fluid package and likewise its own property package and set of components. Sub-flowsheets can be accessed from the main flowsheet object through the flowsheet collection object.

### Syntax: Flowsheet Object

```
Dim hyFlowsheet As Flowsheet  
  
Set hyFlowsheet = hyCase.Flowsheet
```

The above syntax, shows how to connect to the flowsheet object of the HYSYS case. This assumes the `hyCase` variable is already set to the `SimulationCase` object in HYSYS. The remaining examples in this module assume a `SimulationCase` object 'hyCase' is already set.

The example below, shows how to connect to a sub-flowsheet of a flowsheet. Sub-flowsheets are accessed from the main flowsheet. The main flowsheet is accessed through the `SimulationCase`.

### Example: Connecting Flowsheets

```
Dim hyFlowsheet As Flowsheet  
Dim hySubFlowsheets As Flowsheets  
Dim hySubFlowsheet As Flowsheet  
Set hyFlowsheet = hyCase.Flowsheet  
Set hySubFlowsheets = hyFlowsheet.Flowsheets  
Set hySubFlowsheet = hySubFlowsheets.Item(0)
```



## 2.4.3 Basis Objects

The Basis objects refer predominantly to objects handled by the HYSYS BasisManager. The BasisManager object in HYSYS is responsible for handling the global aspects of a HYSYS simulation case. These objects include reactions, components, and property packages.

The BasisManager object is accessed through the SimulationCase object. From the BasisManager object the FluidPackages and HypoGroups collection objects are accessed. Changing the objects accessed directly or indirectly through the BasisManager such as FluidPackages, PropertyPackage, Components, and Hypotheticals requires notification to the HYSYS simulation environment. The BasisManager object contains methods that allow changes to the basis to take place smoothly. The following methods must be used on the outer limits of any code that makes changes to Basis objects.

### Syntax: Changing Basis Values

```
SimulationCase.BasisManager.StartBasisChange  
... changes to components, interaction parameters, reactions, etc.  
SimulationCase.BasisManager.EndBasisChange
```

## FluidPackage(s)

Although both examples of syntax shown below lead you to a FluidPackage object, there are differences that exist which are only apparent when attempting to use the fluid package.

### Syntax: Accessing FluidPackages

#### From the BasisManager

```
SimulationCase.BasisManager.FluidPackages.Item(0)
```

#### From the Flowsheet

```
SimulationCase.Flowsheet.FluidPackage
```

The FluidPackages object returned by the BasisManager object is a collection object containing all FluidPackage objects in a case. Each FluidPackage object can have its own

PropertyPackage object and Components object. When you access the fluid package in this way, changes can be made to the property package and the list of components.

When obtaining a reference to the FluidPackage object from the flowsheet object, you are accessing the one fluid package associated with the flowsheet. You can view the property package or component list of the FluidPackage object, however you are not able to make any changes.

The example below, displays the number of FluidPackage objects in a case and sets a FluidPackage object to the first member of the FluidPackages collection.

**Example: FluidPackage**

```
Dim hyFluidPackages As FluidPackages
Dim hyFluidPackage As FluidPackage
Set hyFluidPackages = hyCase.BasisManager.FluidPackages
MsgBox "Number of Fluid Packages = " & hyFluidPackages.Count
Set hyFluidPackage = hyFluidPackages.Item(0)
```

## PropPackage (PropertyPackage)

The PropPackage object is accessed through the FluidPackage object. Each FluidPackage object can have a single PropPackage object. The type of property package can be determined through the PropPackage *TypeName* property or through the *PropertyPackageName* property of the FluidPackage object. Each property package has a set of unique properties and methods along with the common ones shared among all property packages.

**Syntax to determine the type of property package**

```
SimulationCase.BasisManager.Fluidpackages.Item(0).PropPackage.TypeName
or
SimulationCase.BasisManager.Fluidpackages.Item(0).PropertyPackageName
```

The example below, connects to the FluidPackages collection object and checks each member FluidPackage to see if it contains the *PengRobinson* property package.

**Example: Property Package**

```
Dim hyFluidPackages As FluidPackages
Dim hyFluidPackage As FluidPackage
Dim hyBasis As BasisManager
Dim hyPropPackage As PropPackage
Set hyBasis = hyCase.BasisManager
Set hyFluidPackages = hyBasis.FluidPackages
For Each hyFluidPackage In hyFluidPackages
    If hyFluidPackage.PropertyPackageName = "PengRobinson" Then
        MsgBox "PengRobinson Property Package is Present"
        Set hyPropPackage = hyFluidPackage.PropPackage
    End If
Next hyFluidPackage
```

## Component(s)

The Components object is accessed through the FluidPackage object. Each FluidPackage can have its own unique set of Components.

**Syntax for accessing components****From the BasisManager**

```
SimulationCase.BasisManager.FluidPackages.Item(0).Components
```

**From the Flowsheet**

```
SimulationCase.Flowsheet.Components
```

The example below, shows how to access the Components object associated with a particular FluidPackage object. In this example each component's normal boiling point is checked and a tally of all the components whose boiling point is below 0°C is counted.

**Example: Components**

```
Dim numComp As Integer
Dim hyFluidPackage As FluidPackage
Dim hyBasis As BasisManager
Dim hyComponents As Components
Dim hyComponent As Component
Set hyBasis = hyCase.BasisManager
Set hyFluidPackage = hyBasis.FluidPackages.Item(0)
Set hyComponents = hyFluidPackage.Components
numComp = 0
For Each hyComponent In hyComponents
    If hyComponent.NormalBoilingPointValue < 0 Then
        numComp = numComp + 1
    End If
Next hyComponent
MsgBox numComp & " components have NBP below 0"
```

## Hypotheticals

The HypoGroups collection object is accessed from the BasisManager. This object contains a collection of HypoGroup objects, each of which provides access to a HypoComponents object. A HypoComponent can be entirely specified through Automation and added to a HYSYS simulation case. Methods for the HypoComponent object are used to estimate properties based on the minimum data requirement.

**Syntax: Hypotheticals**

```
SimulationCase.BasisManager.HypoGroups.Item(0).HypoComponents.Item(0)
```

The example below, adds a hypothetical component and sets its boiling point value in order to estimate the remaining properties. The StartBasisChange and EndBasisChange methods are invoked prior to adding this hypothetical to the case.

**Example: HypoComponent**

```
Dim hypGroups As HypoGroups
Dim hypoComp As Object
hyCase.BasisManager.StartBasisChange
Set hypGroups = hyCase.BasisManager.HypoGroups
hypGroups.Add "myhypo"
hypGroups.Item("myhypo").HypoComponents.Add "mycomponent", "userhypo"
Set hypoComp =
    hypGroups.Item("myhypo").HypoComponents.Item("mycomponent*")
hypoComp.NormalBoilingPointValue = 300
hypoComp.Estimate
MsgBox hypoComp.NormalBoilingPointValue
hyCase.BasisManager.EndBasisChange
```

Hypotheticals have a \* appended to the name once they are created.

## 2.4.4 Oils Objects

Oils objects refer to the objects accessed through the Oil Manager. The OilManager object is set through the BasisManager and contains Assay and Blend objects.

### OilManager

Set through the BasisManager, the OilManager object provides access to the oils environment. Like changes made to the objects accessed through the BasisManager, notification to the simulation environment is required when modifying assays or blends. This is accomplished by calling the StartOilChange and EndOilChange methods. Calling the StartOilChange method before calling the StartBasisChange method by default causes the StartBasisChange method to be invoked.

### Example: Accessing the Oil Manager Environment

```
Public hyOil As OilManager
hyCase.BasisManager.StartBasisChange
hyCase.BasisManager.StartOilChange
Set hyOil = hyCase.BasisManager.OilManager
'//code to manipulate oil manager objects
hyCase.BasisManager.EndOilChange
hyCase.BasisManager.EndBasisChange
```

Assays and Blends are not estimated until the EndOilChange method is invoked.

## AssaysCollection & Assays

The AssaysCollection object is accessed through the OilManager object and contains the assay objects available within a particular HYSYS case. There are eight types of assays available and each of them has a specific set of properties and methods.

| AssayTypes:   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• at_ASTMD2887 = 4</li> <li>• at_BulkPropertiesOnly = 7</li> <li>• at_Chromatograph = 5</li> <li>• at_D1160 = 2</li> </ul> | <ul style="list-style-type: none"> <li>• at_D86 = 1</li> <li>• at_D86D1160 = 3</li> <li>• at_EFV = 6</li> <li>• at_TBP = 0</li> </ul> |

The properties associated with the hypocomponents generated by the OilManager can be accessed through the Assay object.

### Syntax: Assays

#### Referencing a Collection

```
Set hyAssays = hyCase.BasisManager.OilManager.Assays
```

#### Referencing a Member

```
Set hyAssay = hyCase.BasisManager.OilManager.Assays.Item("name")
```

#### Adding an Assay

```
hyCase.BasisManager.OilManager.Assays.Add "name", AssayType
```

Below is an example on creating an assay.

#### Example: Creating Assays

```
Dim hyAssay As AssayTBP
Dim hyBasis As BasisManager
Set hyAssay = hyBasis.OilManager.Assays.Add("AssayName", "TBP")
With hyAssay
    .Basis = ab_LiquidVolumeFraction
    .BulkMolecularWeight = 300
    .BulkMassDensity.SetValue 783, "API"
    Dim hyValue As Variant
    Dim hyPercent As Variant
    hyPercent = Array(0,10,20,30,40,50,60,70,80,90,98)
    hyValue =
        Array(26.67,123.89,176.11,221.11,275,335,399,490.56,590.56,691.67,
            795.56)
    .AssayPercentForBoilingTemperature = hyPercent
    .BoilingTemperatureValue = hyValue
    .Calculate
End With
```

## Blend(s)

Blends are created through the BasisManager and can be completed by specifying at least one assay. Multiple assays can be used in a blend as long as flow rates for each of the assays is specified. A large number of blend properties for the hypocomponents created can be viewed.

#### Syntax for Blends

##### Referencing a Collection

```
Set hyBlends = hyCase.BasisManager.OilManager.Blends
```

##### Referencing a Member

```
Set hyBlend = hyCase.BasisManager.OilManager.Blend.Item("blendname")
```

##### Adding Assay to Blend

```
HyBlend.AddAssay "AssayName"
```

##### Installing to a ProcessStream

```
hyBlend.InstallIntoStream "StreamName"
```

The example below, creates a blend, assigns one assay to the blend, and then prints out the TBP values for the blend. The blend is also assigned to a stream in the HYSYS case.

**Example: Blends**

```
Dim hyBlend As Blend
'//create blend and assign assay
Set hyBlend = hyBasis.OilManager.Blends.Add("BlendName")
hyBlend.AddAssay "AssayName"
'//print out some properties
Dim hyVar As Variant
hyvar = hyBlend.TrueBPTemperatureValue
For i = 0 To UBound(hyVar)
    Debug.Print hyVar(i)
Next i
hyBlend.InstallIntoStream "Blend_Stream"
```

## 2.4.5 Stream Objects

The main objects of the stream category are the ProcessStream and Fluid objects. The Fluid object is a type of Stream object that is not connected to operations but can be derived from a ProcessStream. The Fluid object can be manipulated without effecting the operations and streams within the case. The ProcessStream object can be accessed from either the flowsheet or the operation to which it is connected.

### ProcessStream

The Streams object is a collection object returned by the flowsheet. The Streams collection contains one or more ProcessStream objects. There are approximately 124 properties associated with the ProcessStream, including attributes such as temperature, pressure, density, and viscosity. These properties return values of type Double. The ProcessStream object also returns arrays as variants for properties such as ComponentMassFraction.



The Fluid object contains a similar set of properties and methods.

**Syntax for accessing the ProcessStream object****By Name**

```
SimulationCase.Flowsheet.MaterialStreams("streamname")  
SimulationCase.Flowsheet.MaterialStreams.Item("streamname")
```

**By Index**

```
SimulationCase.Flowsheet.MaterialStreams.Item(j)
```

In most instances the collection object and member object of the collection have nearly similar names. The name of the collection object is normally the member name with an "s" at the end. The Streams collection is an exception to this statement, since it contains a collection of ProcessStream objects. The flowsheet returns three stream collections; MaterialStreams, EnergyStreams, and Streams. All three stream collections accessed through the flowsheet are Streams objects. The difference between the Streams collection objects relates to how the member ProcessStream objects are filtered.

The example below, shows how to access a particular stream in the system by index and how to retrieve the temperature value. The remaining properties are accessed in a similar fashion.

**Example 1: ProcessStream**

```
Dim hyFlowsheet As Object  
Dim hyStream As Object  
Set hyFlowsheet = hyCase.Flowsheet  
Set hyStream = hyFlowsheet.MaterialStreams.Item(0)  
MsgBox "Stream Temperature = " & hyStream.TemperatureValue
```

The example below, shows how to access the MassFractionValue for each component in the stream. An array of doubles is returned to the variant hyCompFrac. The Ubound function is used to determine the upper bound of the array and thus the number of components. A separate object is set for the component collection. The indexing between the array of mass fractions and the list of components in the FluidPackage is identical so it is easy enough to match the values with the appropriate components.

#### Example 2: ProcessStream

```
Dim hyFlowsheet As Flowsheet
Dim hyStream As ProcessStream
Dim hyComponents As Components
Dim hyCompFrac As Variant
Set hyFlowsheet = hyCase.Flowsheet
Set hyComponents = hyCase.BasisManager.FluidPackages.Item(0).Components
Set hyStream = hyFlowsheet.MaterialStreams.Item(2)
hyCompFrac = hyStream.ComponentMassFractionValue
For j = 0 To UBound(hyCompFrac)
    MsgBox "Component " & hyComponents.Item(j) & " Mass Fraction = " &
        hyCompFrac(j)
Next j
```

## Fluid

A Fluid object is derived from a single ProcessStream through the DuplicateFluid method. A Fluid object is essentially an internal copy of the ProcessStream that can be manipulated for property calculation purposes. The ProcessStream and Fluid share many of the same properties. A Fluid however can be flashed without interfering with the simulation case.

#### Syntax for creating a fluid

```
SimulationCase.Flowsheet.MaterialStreams("streamname").DuplicateFluid
```

The example below, shows how to create a Fluid off of a stream and use the Fluid to perform a flash calculation. The DuplicateFluid method returns a Fluid object. A variety of flashes could have been performed, but in this case a pressure-vapour fraction flash is run with the desired pressure and vapour fraction used as arguments to the method.

**Example: Fluid**

```
Public Sub FluidExample(pressureval As Double)
  Dim hyFluid As Fluid
  Dim hyStream As ProcessStream
  Set hyStream = hyCase.Flowsheet.MaterialStreams.Item(0)
  Set hyFluid = hyStream.DuplicateFluid
  hyFluid.PVFlash pressureval, 0
  MsgBox "Bubble Point Temperature = " & hyFluid.TemperatureValue
End Sub
```

# FluidPhase(s)

The FluidPhases collection object is derived from the Fluid object. Each FluidPhase in the collection contains a set of properties and methods that are similar to the Fluid itself except that the properties correspond to a specific phase of the Fluid.

| PhaseTypes (constants):   |   |
|---|---|
| <ul style="list-style-type: none"><li>• ptUnknownPhase</li><li>• ptCombinedLiquidPhase</li><li>• ptCombinedPhase</li><li>• ptLiquid2Phase</li></ul> | <ul style="list-style-type: none"><li>• ptLiquidPhase</li><li>• ptPolymerPhase</li><li>• ptSolidPhase</li><li>• ptVapourPhase</li></ul> |

The PhaseType property of the FluidPhase objects can be accessed to determine the type of phase.

**Syntax: FluidPhase(s)**
**Through Collection**

```
Set hyFluidPhase = hyFluid.FluidPhases.Item(0)
```

**HeavyLiquidPhase**

```
Set hyFluidPhase = hyFluid.HeavyLiquidPhase
```

**LightLiquidPhase**

```
Set hyFluidPhase = hyFluid.LightLiquidPhase
```

**VapourPhase**

```
Set hyFluidPhase = hyFluid.VapourPhase
```

The example below, enumerates through the FluidPhases of a Fluid and displays the phase type for each fluid in a property view.

**Example: FluidPhase**

```
Dim i As Integer
Dim hyCase As SimulationCase
Dim hyfluid As Fluid
Dim hystream As ProcessStream
Dim hyPhase As FluidPhase
Dim hyPhases As FluidPhases
Set hystream = hyCase.Flowsheet.MaterialStreams.Item(0)
Set hyfluid = hystream.DuplicateFluid
Set hyPhases = hyfluid.FluidPhases
i = 1
For Each hyPhase In hyPhases
    If hyPhase.PhaseType = ptVapourPhase Then
        MsgBox "Phase " & i & " is the vapour phase"
        i = i + 1
    End If
Next
```

## 2.4.6 Operation Objects

A majority of the unit operations in HYSYS are accessible as Automation objects. Operations can be accessed through the flowsheet object. Each operation typically has a characteristic set of properties and methods.

## Operations

All operations have a few properties and methods in common. Operation objects contain properties for determining the feeds, products, and additional objects connected to the operation. The operation objects also contain methods for adding and removing the operations from the flowsheet and the HYSYS case.

### Syntax for accessing operations

#### Getting all the operations on the flowsheet

```
SimulationCase.Flowsheet.Operations
```

#### Getting a specific collection of operations

```
SimulationCase.Flowsheet.Operations("PumpOp")
```

#### Getting to a specific operation by name

```
SimulationCase.Flowsheet.Operations.Item("UnitName")
```

#### Determining the type of operation

```
SimulationCase.Flowsheet.Operations.Item(0).TaggedName
```

The Operations collection object obtained from the flowsheet returns a collection of all the operations on that flowsheet. It is possible to filter the collection of operations returned by specifying the operation type. It is important to note however that the operations object always returns a collection and not an individual operation. The objects in the collection need to be checked in order to find a specific type of operation.

The example below, enumerates through all the operations on the flowsheet and displays the unit type in a property view.

### Example: Operation

```
Dim i As Integer
Dim hyOperations As Operations
Set hyOperations = hyCase.Flowsheet.Operations
For i = 0 To hyOperations.Count - 1
    MsgBox "Operation " & hyOperations.Item(i).name & "
        is unit type - & hyOperations.Item(i).TypeName
Next i
```

## ColumnOp & ColumnFlowsheet

The column operation is a special kind of operation in HYSYS and actually contains its own flowsheet. The ColumnFlowsheet is accessed either from the Columnop object or as a member of the flowsheets object accessed through the main flowsheet. In order to access the various temperatures, pressures, and specifications for a column the ColumnFlowsheet must be accessed.

### Syntax: Accessing Columns

```
Set objColumn = SimulationCase.Flowsheet.Operations("ColumnOp").Item(0)
Set objColumnSubFlow = objColumn.ColumnFlowsheet
```

The ColumnFlowsheet object contains a considerable amount of information regarding the column. A variant is used to receive an array of column pressure information and displays a stage by stage breakdown of the pressure values.

### Example: Column Operation

```
Dim hyColumn As ColumnOp
Dim hyColumnSubFlowsheet As ColumnFlowsheet
Dim Pressure_Profile As Variant
Set hyColumn = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
Set hyColumnSubFlowsheet = hyColumn.ColumnFlowsheet
Pressure_Profile = hyColumnSubFlowsheet.Pressures
For i = 0 To UBound(Pressure_Profile)
    MsgBox "Stage " & i + 1 & " pressure = " & Pressure_Profile(i)
Next i
```

## ColumnSpecification(s)

A column is solved based on matching specifications related to the available degrees of freedom. The ColumnSpecifications collection object is accessed through the ColumnFlowsheet. The ColumnSpecification contains information such as the goal value, current value, and status.

### Syntax: ColumnSpecification

```
Set hyColumn = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
Set hyColumnFlowsheet = hyColumn.ColumnFlowsheet
```

### By Index:

```
Set hyColumnSpec = hyColumnFlowsheet.Specifications.Item(0)
```

### By name:

```
Set hyColumnSpec = hyColumnFlowsheet.Specifications.Item("specname")
```

The example below, enumerates through all the column specifications and displays in a property view whether the specification is active or an estimate.

### Example: ColumnSpecification

```
Dim hyColumnSpec As ColumnSpecification
Dim hyColumnSpecs As ColumnSpecifications
Dim hyColumn As ColumnOp
Dim hyColumnFlowsheet As ColumnFlowsheet
Set hyColumn = hyCase.Flowsheet.Operations("ColumnOp").Item(1)
Set hyColumnFlowsheet = hyColumn.ColumnFlowsheet
Set hyColumnSpecs = hyColumnFlowsheet.Specifications
For Each hyColumnSpec In hyColumnSpecs
    If hyColumnSpec.IsActive Then
        MsgBox "Column spec '" & hyColumnSpec & "' is active."
    Else
        MsgBox "Column spec '" & hyColumnSpec & "' is an estimate."
    End If
Next hyColumnSpec
```

## ColumnStage(s) & SeparationStage

The ColumnStages object is a collection of ColumnStage objects accessed through ColumnFlowsheet. SeparationStage is an object of ColumnStage and provides a variety of properties related to the fluids residing on a particular column stage.

**Syntax: ColumnStage(s)**
**By Index:**

```
Set hyColumnStage = hyColumnFlowsheet.ColumnStages.Item(0)
```

**By Name:**

```
Set hyColumnStage = hyColumnFlowsheet.ColumnStages.Item("1_Main TS")
```

**Syntax: SeparationStage**

```
Set hySepStage = hyColumnStage.SeparationStage
```

The example below, loops through each feed stage and displays in the Debug property view its molar liquid flows.

**Example: ColumnStage**

```
Dim hyColumn As ColumnOp
Dim hyColumnFlowsheet As ColumnFlowsheet
Dim hyFeedStage As Object
Dim hySepStage As SeparationStage
Set hyColumn = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
With hyColumn.ColumnFlowsheet
    For Each hyFeedStage In .FeedStages
        Debug.Print "Stage " & .ColumnStages(hyFeedStage.name)
        StageNumberValue & " Molar Liquid Flow (kgmole/hr) is "
        & .ColumnStages(hyFeedStage.name).
        SeparationStage.MolarLiquidFlowValue
    Next hyFeedStage
End With
```

## 2.4.7 Support Objects

Support objects are used primarily to perform a function or service to an object in HYSYS. Support objects may not have a visible equivalent in a HYSYS case when viewed within the simulation environment. The support objects can be accessed by several of the objects in HYSYS. The two most commonly



accessed objects in this category are FixedAttachments and RealVariable.

## RealVariable/RealFlexVariable

The RealVariable object provides additional information about a particular variable such as its units and whether it is calculated or set. HYSYS performs all calculations in SI units regardless of how the user preference settings are set. By default, the values returned through Automation are also in SI units. It becomes your responsibility to handle how units are handled when writing applications.

A RealVariable contains a property called GetValue and SetValue which allows one to specify the units that are to be used when returning or setting the value.

### Syntax for using RealVariable

```
SimulationCase.Flowsheet.MaterialStreams.Item(0).property
```

### RealVariable Properties/Methods

|          |                                     |
|----------|-------------------------------------|
| GetValue | Gets the value in a specified unit. |
| SetValue | Sets the value in a specified unit. |
| Status   | Returns calculated or specified     |
| Value    | Value in SI units.                  |

The RealVariable object also contains a property called Value. The Value property returns the actual value in SI units within the HYSYS case. Many of the objects that return a RealVariable for a given property also have a similarly named property with the word value concatenated to it. The alternative property allows direct access to the actual variable in SI units with one less function call. An example for the ProcessStream object would be the Temperature property that returns a RealVariable and the TemperatureValue property, that returns a value in °C.

The RealFlexVariable contains roughly the same properties and methods as the RealVariable but is used for array values returned to variants.

The presence of **Flex** in the object name indicates the possibility of a dynamic array (in other words, has a **variable** size, depending on what is being returned.)

The example below, shows how to get a stream property value in a specific unit using the RealVariable method GetValue.

#### Example 1: RealVariable

```
Dim hyStream As ProcessStream
Dim TemperatureVal As Double
Set hyStream = hyCase.Flowsheet.MaterialStreams.Item(0)
TemperatureVal = hyStream.Temperature.GetValue("F")
MsgBox hyStream.name & " temperature(F) = " & TemperatureVal
```

The example below, shows how to set a stream property value in a specific unit using the RealVariable method SetValue.

#### Example 2: RealVariable

```
Dim hyStream As ProcessStream
Dim TemperatureVal As Double
Set hyStream = hyCase.Flowsheet.MaterialStreams.Item(0)
TemperatureVal = 150
hyStream.Temperature.SetValue 150, "F"
```

The example below, checks how the temperature value of a stream is determined by examining the state property.

#### Example 3: RealVariable

```
Dim hystream As ProcessStream
Set hystream = hyCase.Flowsheet.MaterialStreams.Item(0)
Select Case hystream.Temperature.State
Case vsCalculated
    MsgBox "Temperature value is calculated."
Case vsSpecified
    MsgBox "Temperature value is specified."
Case vsDefaultedValue
    MsgBox "Temperature value is default."
End Select
```

The constants vsCalculated, vsSpecified, and vsDefaultedValue are integer variables specified in the type library.

## Fixed Attachments

The FixedAttachments object is a collection object accessed from Operations or Stream objects. The FixedAttachments collection object contains a set of objects related to the feeds, products, or connected operations.

### Syntax: Using FixedAttachments

```
Set FixAtch = SimulationCase.Flowsheet.Operations.Item(0).AttachedFeeds
Set hyStream = FixAttachObj.Item(0)
```

### Types of objects a FixedAttachments Collection

|                    |                 |
|--------------------|-----------------|
| AttachedFeeds      | - ProcessStream |
| AttachedProducts   | - ProcessStream |
| AttachedLogicalOps | - UnitOperation |
| AttachedOpers      | - UnitOperation |

The example below, shows how to determine the streams attached to a specific unit operation. This example selects the first column in the operations collection object and then sets an object to the attached feeds of the column. The names of the feed streams to the column appear in a property view.

### Examples: FixedAttachments

```
Dim hyFeeds As FixedAttachments
Dim hyOp As ColumnOp
Set hyOp = hyCase.Flowsheet.Operations("ColumnOp").Item(0)
Set hyFeeds = hyOp.AttachedFeeds
For j = 0 To hyFeeds.Count - 1
    MsgBox "FeedStream " & j & " Name = " & hyFeeds.Item(j).name
Next j
```

## Solver & Integrator

The Solver is accessed from the SimulationCase object. The Solver object can be used to turn the calculations on and off.

### Syntax for the Solver and Integrator

#### Solver

```
SimulationCase.Solver.CanSolve = False  
SimulationCase.Solver.CanSolve = True
```

#### Integrator

```
SimulationCase.Solver.Integrator.Active = True  
SimulationCase.Solver.Integrator.Active = False
```

When accessing HYSYS through Automation it is important to note that HYSYS does not allow communication while it is solving. If information is sent to HYSYS from a client application, HYSYS does not return control to the calling program until calculations are complete. If it is necessary to pass a large amount of information to HYSYS it is best to turn the solver off first and then turn it on once the information is sent. Otherwise, HYSYS calculates after each piece of information is sent and it takes much longer to transfer the data.

### Example: Starting/Stopping the Solver

```
Dim hystream As ProcessStream  
Set hystream = hyCase.Flowsheet.MaterialStreams.Item(0)  
hyCase.Solver.CanSolve = False  
hystream.Temperature.SetValue 100, "F"  
hystream.Pressure.SetValue 1, "atm"  
hystream.MassFlow.SetValue 1000, "lb/hr"  
hyCase.Solver.CanSolve = True
```

## SpreadsheetOp & SpreadsheetCell(s)

The SpreadsheetCells object is a collection of SpreadsheetCell objects. The cell properties allow access to information related to the HYSYS variable being imported or exported, the formulas associated with the cell, and the value within the cell.

### Syntax: SpreadsheetOp and SpreadsheetCell(s)

```
Set hySS = hyCase.Flowsheet.Operations.Item("spreadsheetname")
Set hyCell = hySS.Cell(columnindex, rowindex)
```

By utilizing the spreadsheet operation, it is possible to access nearly every property or value in HYSYS even if the object associated with that property is not exposed as an Automation interface.

### Example: Accessing Spreadsheet Cells

```
Dim hySS As SpreadsheetOp
Dim hyCell As SpreadsheetCell
Set hySS = hyCase.Flowsheet.Operations("spreadsheetop").Item(0)
Dim x As Variant, y As Variant
For i = 0 To 5
    x = 1 ' col #
    y = i ' row #
    Set hycell = hySS.Cell(x,y)
    Debug.Print "CELL VALUE = " & hyCell.CellValue
    Debug.Print "CELL FORMULA = " & hyCell.CellText
    Debug.Print "CELL PROPERTY = " & hyCell.VariableName & " (" &
        hyCell.Units & ")"
Next i
```

## 2.4.8 PFD Objects

PFD objects are used for the manipulation and automation of PFDItems. A PFDItem is any item that is found on the HYSYS PFD, such as a unit op or a stream. You can use PFD objects to Move, Size, Mirror, Rotate, Hide, etc. any PFDItem. PFD objects also allow you to import and display a selection of PFDItems in to Visio, a CAD application or Excel (what items you get depends on what parameters you specify). In addition to manipulating the PFD you can use the PFDConnection object for such things as finding the "stream line" route between two PFDItems.

### Example: Nozzle Type

```
If nozzle.NozzleType = pfdInletFromMaterialStream Or  
nozzle.NozzleType = pfdOutletToMaterialStream Or nozzle.NozzleType =  
pfdInletFromStream Or nozzle.NozzleType = pfdOutletToStream Then  
    newLine.Line.ForeColor.RGB = RGB(0, 0, 128)  
    newShape.Fill.ForeColor.RGB = RGB(128, 128, 128)  
ElseIf nozzle.NozzleType = pfdInletFromEnergyStream Or  
nozzle.NozzleType = pfdOutletToEnergyStream Then  
    newLine.Line.ForeColor.RGB = RGB(128, 0, 0)  
    newShape.Fill.ForeColor.RGB = RGB(128, 128, 128)  
ElseIf nozzle.NozzleType = pfdMaterialStreamInlet Or  
nozzle.NozzleType = pfdMaterialStreamOutlet Then  
    newLine.Line.ForeColor.RGB = RGB(0, 0, 128)  
    newShape.Fill.ForeColor.RGB = RGB(0, 0, 128)  
    newShape.Line.ForeColor.RGB = RGB(0, 0, 128)  
ElseIf nozzle.NozzleType = pfdEnergyStreamInlet Or nozzle.NozzleType  
= pfdEnergyStreamOutlet Then  
    newLine.Line.ForeColor.RGB = RGB(128, 0, 0)  
    newShape.Fill.ForeColor.RGB = RGB(128, 0, 0)  
    newShape.Line.ForeColor.RGB = RGB(128, 0, 0)  
Else  
    newLine.Line.ForeColor.RGB = RGB(0, 255, 0)  
End If
```

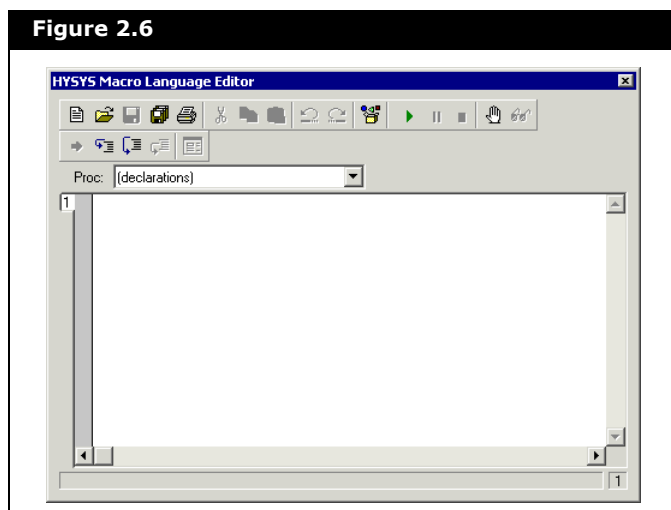
## 2.5 Example 1: The Macro Language Editor

In this example, you use the HYSYS Macro Language Editor to build a macro tool that displays the Mach number for a selected stream over a number of different pipe sizes. The speed of sound in the stream fluid also appears. The fluid velocity calculated for each pipe size is the average fluid velocity; no attempt is made to estimate the maximum velocity.

This complete example has also been pre-built and is located in the HYSYS\Samples\OLE\macros\mach directory.

1. Begin by opening HYSYS and the Macro Language Editor which is found under the **Tools** menu.

**Figure 2.6**



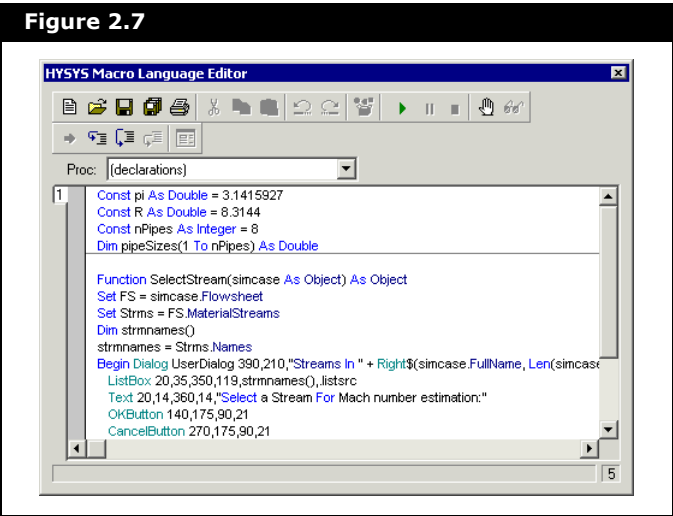
2. Add a function that returns the Stream object that you choose from a list. Creating separate functions allows for easy re-use in other programs.

| Code   | Explanation   |
|--|---|
| <b>Function SelectStream(simcase As Object) As Object</b>  | Signifies the beginning of the SelectStream function. This function takes a SimulationCase object and prompts the user to select a Stream from a list of streams in the case, returning an interface to the Stream.   |
| Set FS = simcase.Flowsheet   | Acquire the case flowsheet.   |
| Set Strms = FS.MaterialStreams   | Acquire the collection of Streams from the flowsheet.   |
| Dim strmnames()<br>strmnames = Strms.Names   | Build a string array of the Stream names.   |
| Begin Dialog UserDialog 390,210,"Streams in " +<br>Right\$(simcase.FullName, Len(simcase.FullName) -<br>Len(simcase.Path))<br>ListBox 20,35,350,119,strmnames(),.listsrc<br>Text 20,14,360,14,"Select a Stream for Mach<br>number estimation:"<br>OKButton 140,175,90,21<br>CancelButton 270,175,90,21<br>End Dialog | Generate a user property view containing a list of Streams<br>Please notice that the first button created automatically becomes the default.<br><br>Use the <b>Language Help</b> option provided in the <b>Help</b> menu to explore the use of <b>UserDialogs</b> . |
| Dim dlg As UserDialog<br>If Dialog(dlg) = 0 Then End   | Finally, run the Dialog and terminate the macro if the user cancels (i.e., Dialog function returns 0).  |
| Set SelectStream = Strms(dlg.listsrc)  | Set the function's return value to the user selected stream interface.  |
| <b>End Function</b>  | Signifies the end of the function. This line does not need to be added.   |

The "\_" appears at the end of any line of code indicates that the following line is a continuation of the present line.



3. At this time it is probably a good idea to globally declare some constants that are used in the Main sub-routine as shown below.



4. You can now begin defining the Main sub-routine. Enter the following code:

| Code  | Explanation   |
|---|---|
| <b>Sub Main</b>   | Signifies the beginning main sub-routine.   |
| <pre>pipeSizes(1) = 2 pipeSizes(2) = 3 pipeSizes(3) = 4 pipeSizes(4) = 6 pipeSizes(5) = 8 pipeSizes(6) = 10 pipeSizes(7) = 12 pipeSizes(8) = 16</pre> | Defines an array of pipe sizes (in inches).   |
| <pre>Dim simcase As Object Set simcase = ActiveCase If simcase Is Nothing Then   MsgBox "No HYSYS case is open." End End If</pre>                     | Looks for an open active case. If there is no active case, it alerts the user and terminates. |
| <pre>Dim strm As Object Set strm = SelectStream(simcase)</pre>  | Calls the <b>SelectStream</b> function to select a stream in the simcase.                     |

| Code  | Explanation  |
|---|--|
| <pre> Set flow = strm.MassFlow If flow.IsKnown Then     flowValue = flow.GetValue("lb/hr")     flowValue = flowValue / 3600 Else     GoTo NoFlow End If </pre>  | Check to see if the selected stream has a defined mass flow rate. If the flow rate is known, convert the flow rate in to "lb/s".   |
| <pre> Set rho = strm.MassDensity If rho.IsKnown Then     rhoValue = rho.GetValue("lb/ft3") Else     GoTo NoRho End If </pre>  | Checks to see if the stream's mass density has been calculated.  |
| <pre> flowValue = flowValue / rhoValue </pre>   | Calculates volumetric flow rate.   |
| <pre> On Error GoTo NoCv Cv = strm.MolarHeatCapacityValue / strm.CpCvValue </pre>   | Proceeds to an error trap if the Cv value of the stream has not been calculated.   |
| <pre> On Error GoTo NoZ Z = strm.CompressibilityValue </pre>  | Proceeds to an error trap if the compressibility of the stream has not been calculated.  |
| <pre> On Error GoTo NoTemp T = strm.TemperatureValue + 273.15 </pre>  | Proceeds to an error trap if the absolute temperature of the stream cannot be calculated.  |
| <pre> On Error GoTo NoMolWt MolWt = strm.MolecularWeightValue / 1000.0 </pre>   | Proceeds to an error trap if the molecular weight of the stream cannot be calculated.  |
| <pre> soundVel = Sqr(Z*R*T/MolWt*(1.0+Z*R/Cv)) soundVel = soundVel / 0.3048 soundVelTxt = Format(soundVel, "###,###,###.###")  Dim DispText() As String ReDim DispText(nPipes + 2) DispText(0) = "Pipe Size (in)                Mach Number      " DispText(1) = "----- -----" </pre> | <p>Calculates the Speed of Sound of the stream and converts it from m/s to ft/s.</p> <p>Declares an array of String types. The "+2" leaves room for a two line header. The two header lines are assigned.</p> <p>Please note there are eighteen spaces between "(in)" and "Mach" and four spaces after "Number". There are approximately seventy dashes in the line <i>DispText(1) = "----..."</i></p> |

| Code   | Explanation  |
|--|--|
| <pre> For num = 1 To nPipes     rSquared = pipeSizes(num) * pipeSizes(num)/144.0/     4.0     Mach = flowValue / pi / rSquared / soundVel     sizetxt = Format(pipeSizes(num),     "###,###,###.###")     Machtxt = Format(Mach, "###,###,###.#####")     DispText(num + 1) = Format\$(sizetxt,     "#####") + "          " +     Format\$(Machtxt, "#####") Next num </pre>   | <p>For each pipe size, the Mach number is calculated, formatted and stored in the previously created array of strings.</p> <p>Please notice that there are eighteen spaces between the quotation marks in the sixth line of code (ninth line displayed).</p> |
| <pre> Begin Dialog UserDialog 360,217     ListBox 10,49,340,133,DispText(),.Field5     OKButton 250,189,90,21     Text 30,14,150,14,"Speed of Sound (ft/s):",     .Field2     TextBox 190,14,90,21,.Field1 End Dialog Dim dlg2 As UserDialog dlg2.Field1 = soundVelTxt Dialog dlg2 End </pre>  | <p>Create a user property view that displays the Speed of Sound value as well as the Mach number for each of the pipe sizes.</p> <p>Use the <b>Language Help</b> option provided in the <b>Help</b> menu to explore the use of <b>UserDialogs</b>.</p>       |
| <pre> NoFlow:     MsgBox "Unknown mass flow in stream " + strm.name End NoRho:     MsgBox "Unknown density in stream " + strm.name End NoCv:     MsgBox "Unknown heat capacity in stream " +     strm.name End NoZ:     MsgBox "Unknown compressibility in stream " +     strm.name End NoTemp:     MsgBox "Unknown temperature in stream " +     strm.name End NoMolWt:     MsgBox "Unknown molecular weight in stream " +     strm.name End </pre> | <p>This is where you define the error trap instances.</p>  |
| <b>End Sub</b>   | Signifies the end of the method.   |



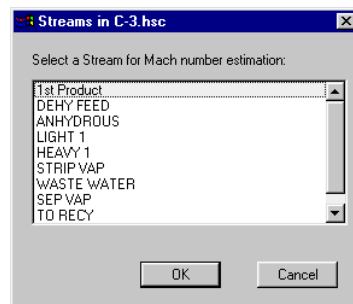
Start/Resume icon

5. Once you have finished adding this code, you should be ready to run the program. First ensure that HYSYS has a case loaded with at least one fully defined stream. You can start the program using one of the following ways:

- Right-click on any area of the Macro Language Editor property view, select **Macro | Run** command from the Object Inspect menu.
- Pressing the **F5** on the keyboard.
- Clicking the **Start/Resume** icon on the toolbar.

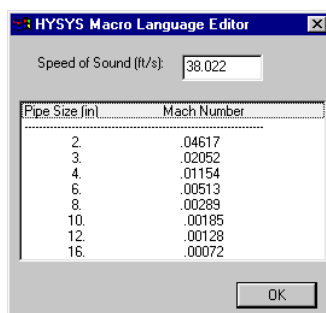
You should see a property view similar to the one shown below:

Figure 2.8



6. Select a stream from the list and click the **OK** button. This should result in a property view similar to the one shown below.

Figure 2.9



7. Be sure to save the program by doing one of the following:

- Right-click on any area of the Macro Language Editor property view, select **File | Save** from the Object Inspect menu.
- Press the **CTRL S** hot key combination.
- Clicking the **Save** icon in the toolbar.



Save icon

## 2.6 Example 2: Automation in Visual Basic

In this example HYSYS is used as the Automation server for a unit conversion program. More specifically, you are accessing an object called the UnitConversionManager which manages unit conversion within HYSYS.

**Although Visual Basic 5.0 is recommended for this example, you can create this Automation application in Visual Basic Editor provided in MS Excel 97® and MS Word 97®.**

**The completed Example 2 has been pre-built and is located in the HYSYS\Samples\OLE\vb\ ucsn directory.**



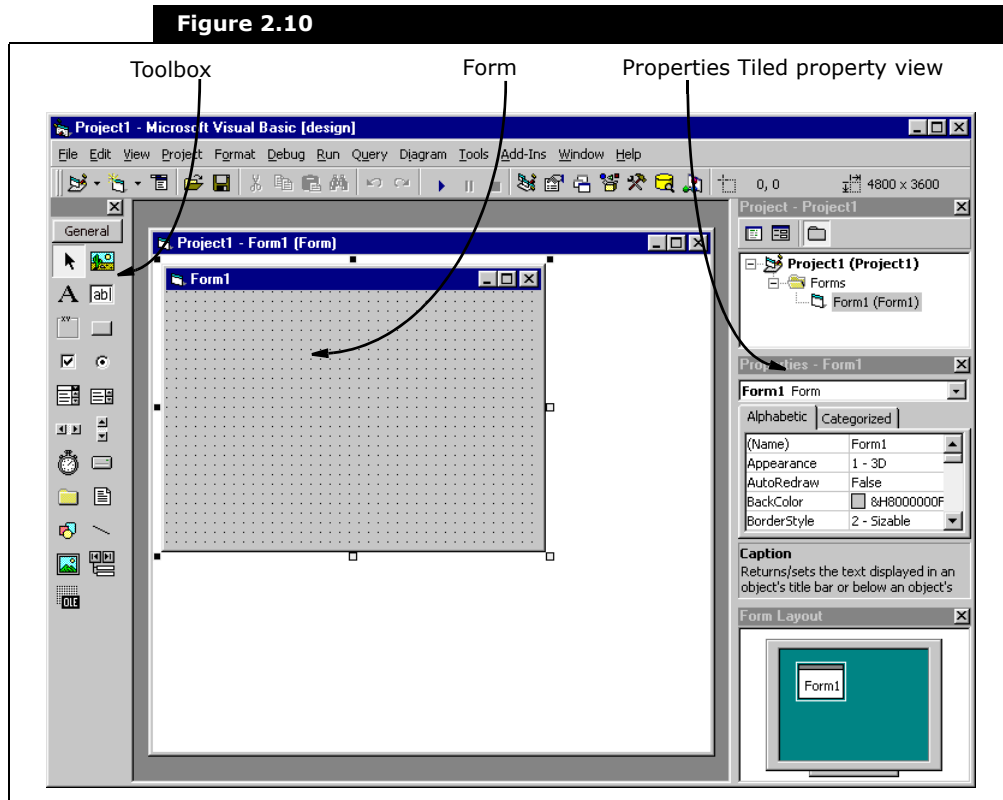
Standard EXE

Standard EXE icon

1. Open a new project in Visual Basic 6.0® and from the **New** tab of the New Project property view select the **Standard EXE** icon and click the **Open** button.

Your screen should appear similar to the figure below.

**Figure 2.10**

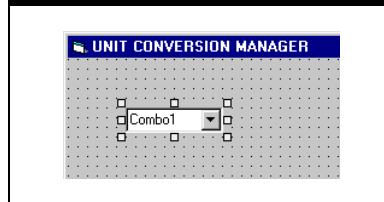


2. By default you should have a form associated with the project. Begin, by giving the form a name. In the **Name** field of the Properties tiled property view give the form the name: **frmUCSM**.
3. In the **Caption** field type: **UNIT CONVERSION MANAGER**. This caption should now appear in the Title Bar of the form.
4. Before adding objects to the form, resize the property view to accommodate the different objects that are required. In the **Width** field found in the Properties tiled property view change the width of the form to **12600** or so that the form is sufficiently wide enough to contain all the objects you are adding (see [Figure 2.14](#)).



Combo Box icon

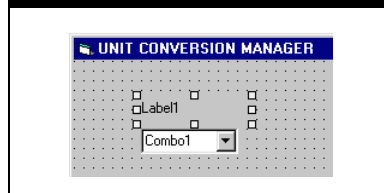
5. From the toolbox select the **Combo Box** icon and create a combo box on the form as shown below.

**Figure 2.11**

6. Ensure that the combo box is the active control. This can be done in one of two ways:
  - Select the combo box on the form so that the object guides appear around the object.
  - From the drop-down list found at the top of the Properties tiled property view select the name of the combo box you have just created.
7. In Properties tiled property view, set the name of the Combo Box as **ddUnitSet** in the **Name** field. If you want, you can also change the default text that appears inside the combo box by entering a new name in the **Text** field.
8. You can add a Label to the form (i.e., to identify the object from others), by clicking the **Label** icon and drawing a label on the form just above the combo box you have just created.



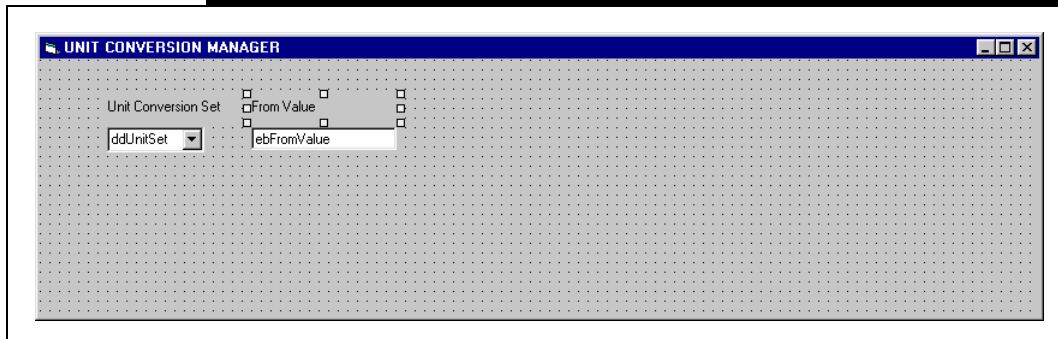
Label icon

**Figure 2.12**

9. Ensuring that the Label control is active using one of the methods suggested in #6, go to Properties tiled property view and change the text in the **Caption** field to **Unit Conversion Set**.

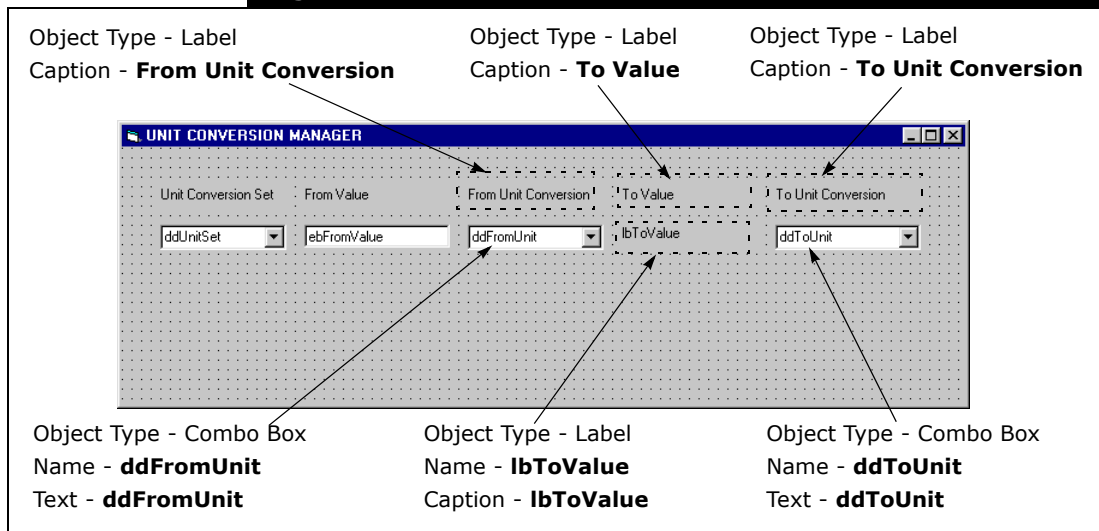
10. Now add an Text Box next to the Combo Box you created. Use the method described in Steps #6 - #7 to name this Text Box **ebFromValue**. Repeat Steps #8 - #9 to add a Label above the ebFromValue Text Box that reads **From Value**.

Figure 2.13



11. Add the following objects to the property view using the previously described methods.

Figure 2.14



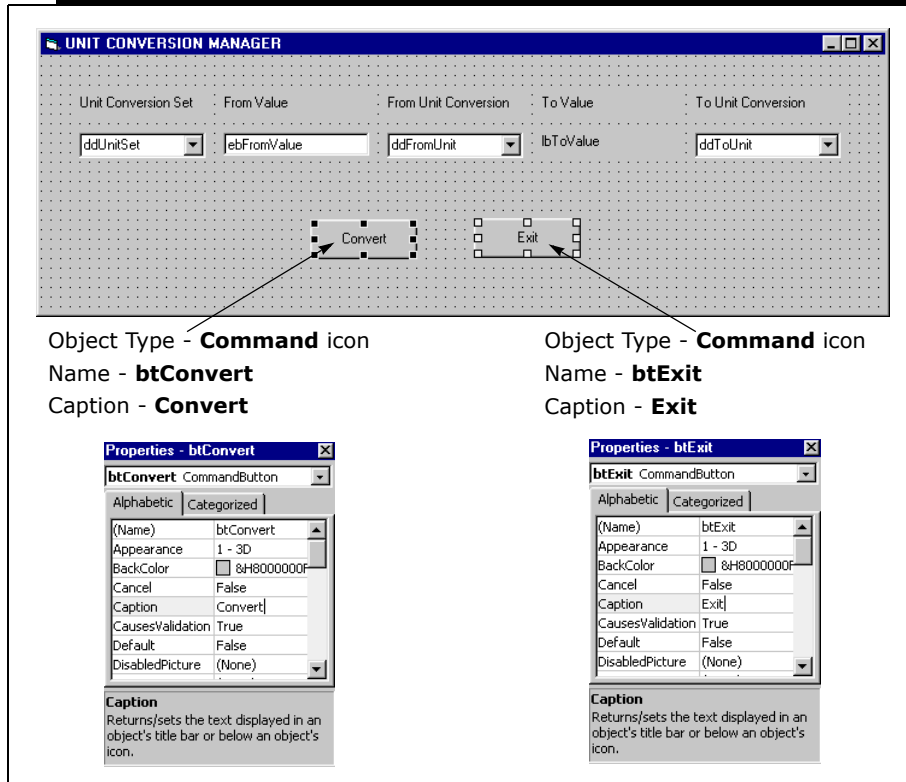




Command icon

12. Only two more objects are required on the form. Select the **Command** icon control from the toolbox and add two buttons to the property view as shown below.

Figure 2.15



13. You are now ready to begin defining the events behind the form and objects. You can enter the code environment using a number of methods:

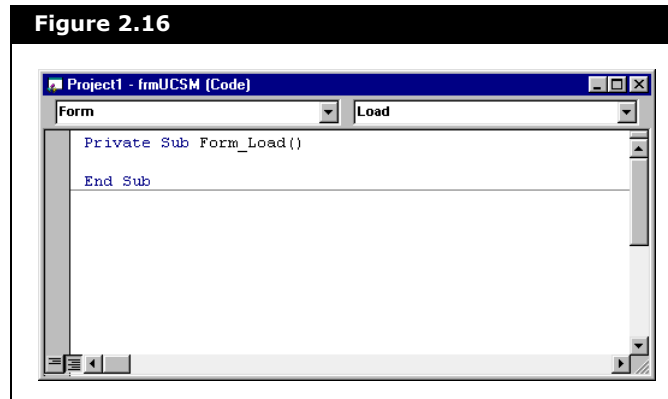


View Code icon

- Click the **View Code** icon in the Project tiled property view.
- Select the **Code** command from the **View** menu.
- Double-click the **frmUCSM** form.

The following property view should appear:

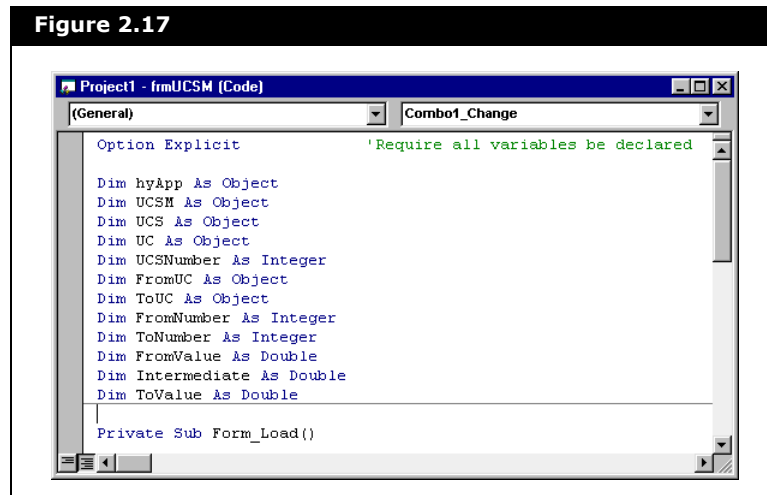
**Figure 2.16**



**The Private Sub Form\_Load() method definition is only visible if you enter the code environment by double-clicking the form.**

14. Begin by declaring the following variables under the Option Explicit declaration.

**Figure 2.17**



**If you attempt to use an undeclared variable, an error occurs at compile time.**

15. The first sub-routine should already be declared. The `Form_Load` sub-routine is the first sub-routine called once the program is run. It is usually used to initialize the variables and objects used by the program. Enter the following code in to the `Form_Load` sub-routine.

| Code   | Explanation  |
|--|--|
| <b>Private Sub Form_Load()</b>   | Signifies the Start of the form load sub-routine. You do not have to add it as it should already be there.                 |
| <code>ddUnitSet.Clear</code><br><code>ddFromUnit.Clear</code><br><code>ddToUnit.Clear</code>                         | Clear the default text found inside the <b>ddUnitSet</b> , <b>ddFromUnit</b> and <b>ddToUnit</b> combo boxes.              |
| <code>Set hyApp = CreateObject("HYSYS.Application")</code><br><code>Set UCSM = hyApp.UnitConversionSetManager</code> | Connects to HYSYS and the HYSYS Unit Conversion Set Manager.   |
| <code>For Each UCS In UCSM</code><br><code>ddUnitSet.AddItem UCS.Name</code><br><code>Next UCS</code>                | For each Unit Conversion Set found in the Unit Conversion Set Manager add the Unit Set to <b>ddUnitSet</b> combo box list. |
| <code>ddUnitSet.ListIndex = -1</code>  | Indicates no item is currently selected in the <b>ddUnitSet</b> combo box.   |
| <code>ebFromValue.Text = ""</code><br><code>lbToValue.Caption = ""</code>  | Clears the text that appears in the <b>ebFromValue</b> text box and the <b>lbToValue</b> label.                            |
| <b>End Sub</b>   | Signifies the end of the initialization sub-routine. This line does not need to be added.                                  |

16. The next section of code to be added tells the program what is to occur when an option is selected in the **ddUnitSet** combo box.

| Code  | Explanation  |
|---|--|
| <b>Private Sub ddUnitSet_Click()</b>  | Signifies the Start of the sub-routine.  |
| <code>ddFromUnit.Clear</code><br><code>ddToUnit.Clear</code>  | Clears any list entries in the <b>ddFromUnit</b> and <b>ddToUnit</b> combo boxes.  |
| <code>Set hyApp = CreateObject("HYSYS.Application")</code><br><code>Set UCSM = hyApp.UnitConversionSetManager</code>                        | Connects to HYSYS and the HYSYS Unit Conversion Set Manager.   |
| <code>UCSNumber = ddUnitSet.ListIndex</code>  | Once the selection is made in the <b>ddUnitSet</b> combo box, the <b>UCSNumber</b> variable holds the internal HYSYS index number of the selected Unit Set.  |
| <code>Set UCS = UCSM.Item(UCSNumber)</code>   | Find the selected Unit Conversion Set in Unit Conversion Manager.  |
| <code>For Each UC In UCS</code><br><code>ddFromUnit.AddItem UC.Name</code><br><code>ddToUnit.AddItem UC.Name</code><br><code>Next UC</code> | For each Unit Conversion type ( <b>UC</b> ) in the Unit Conversion Set, add the Unit type to both the <b>ddFromUnit</b> combo box (the unit type the program is converting from) and the <b>ddToUnit</b> (the unit type the program is converting to). |
| <code>ddFromUnit.ListIndex = -1</code><br><code>ddToUnit.ListIndex = -1</code>  | Indicates no items are currently selected in the <b>ddFromUnit</b> and <b>ddToUnit</b> combo box.  |

| Code                                | Explanation  |
|-------------------------------------|--|
| <code>lbToValue.Caption = ""</code> | Clears any text that appears in the <b>lbToValue</b> label.                |
| <b>End Sub</b>                      | Signifies the end of the sub-routine. This line does not need to be added. |

17. The next 2 sub-routines reset the **lbToValue** label whenever an option is selected in either the **ddFromUnit** or **ddToUnit** combo box.

| Code                                  | Explanation  |
|---------------------------------------|--|
| <b>Private Sub ddFromUnit_Click()</b> | Signifies the Start of the sub-routine.                                    |
| <code>lbToValue.Caption = ""</code>   | Clears any text that appears in the <b>lbToValue</b> label.                |
| <b>End Sub</b>                        | Signifies the end of the sub-routine. This line does not need to be added. |

| Code                                | Explanation  |
|-------------------------------------|--|
| <b>Private Sub ddToUnit_Click()</b> | Signifies the Start of the sub-routine.                                    |
| <code>lbToValue.Caption = ""</code> | Clears any text that appears in the <b>lbToValue</b> label.                |
| <b>End Sub</b>                      | Signifies the end of the sub-routine. This line does not need to be added. |

18. The final two sub-routines define the actions of the two buttons: **btConvert** and **btExit**.

| Code   | Explanation  |
|--|--|
| <b>Private Sub btConvert_Click()</b>   | Signifies the Start of the sub-routine.  |
| <code>Set hyApp = CreateObject("HYSYS.Application")<br/>Set UCSM = hyApp.UnitConversionSetManager</code>             | Connects to HYSYS and the HYSYS Unit Conversion Set Manager.   |
| <code>FromValue = CDBl(Val(ebFromValue.Text))</code>   | Takes the value entered in the <b>ebFromValue</b> text box and converts in to a numerical variable type.   |
| <code>ebFromValue.Text = CStr(FromValue)</code>  | Set <b>ebFromValue</b> text box text equal to FromValue double.  |
| <code>UCSNumber = ddUnitSet.ListIndex<br/>FromNumber = ddFromUnit.ListIndex<br/>ToNumber = ddToUnit.ListIndex</code> | Gets current selection in the three drop-down lists (combo boxes).   |
| <code>If FromNumber &lt; 0 Or ToNumber &lt; 0 Then<br/>    lbToValue.Caption = ""<br/>    Exit Sub<br/>End If</code> | If no selection is made in either the <b>ddFromUnit</b> or <b>ddToUnit</b> combo boxes, exit the sub-routine.                                    |
| <code>Set UCS = UCSM.Item(UCSNumber)<br/>Set FromUC = UCS.Item(FromNumber)<br/>Set ToUC = UCS.Item(ToNumber)</code>  | Chooses a specific UCS from UCSM. It takes the Unit conversion type you want to change from, and the Unit Conversion type you want to change to. |

| Code   | Explanation  |
|--|--|
| <pre>Intermediate = FromUC.ToCalculationUnit(FromValue) ToValue = ToUC.FromCalculationUnit(Intermediate) lbToValue.Caption = CStr(ToValue)</pre> | Converts the contents of the <b>ddFromValue</b> combo box from the <b>FromUC</b> units to HYSYS internal units ( <b>Intermediate</b> ). It then converts the <b>Intermediate</b> value from internal units to the <b>ToUC</b> units. It then displays the converted value in the <b>lbToValue</b> label. |
| <b>End Sub</b>   | Signifies the end of the sub-routine. This line does not need to be added.   |

| Code                              | Explanation  |
|-----------------------------------|--|
| <b>Private Sub btExit_Click()</b> | Signifies the Start of the sub-routine.                                    |
| <pre>Unload Me End</pre>          | Unloads the form and ends the program.                                     |
| <b>End Sub</b>                    | Signifies the end of the sub-routine. This line does not need to be added. |

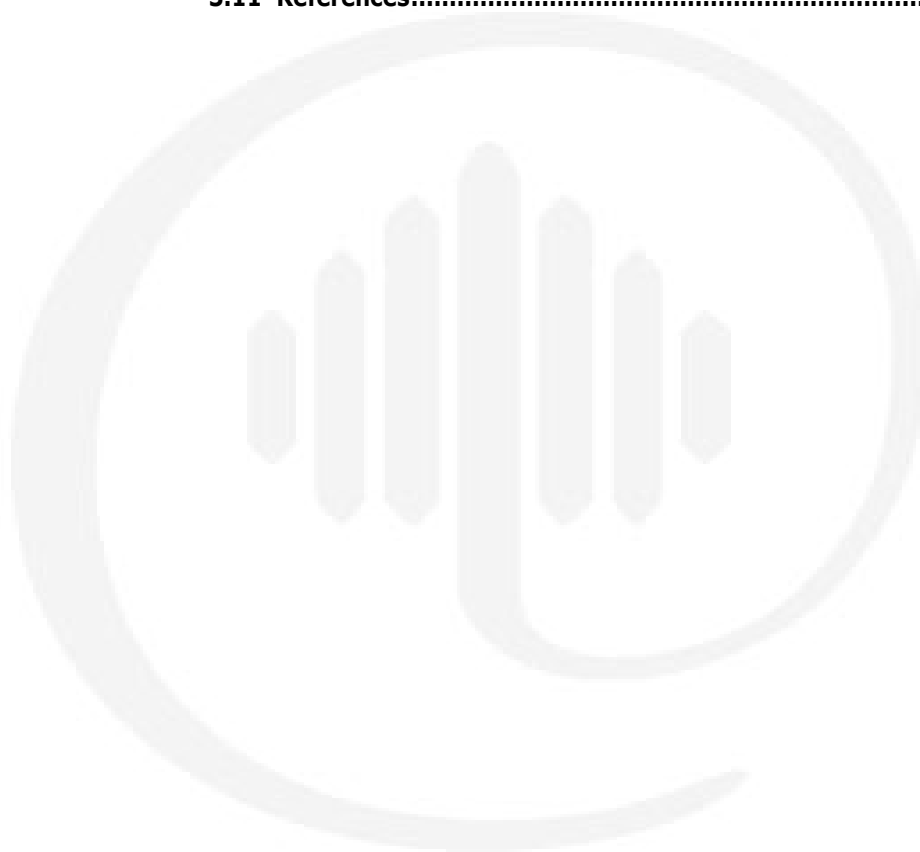
19. You are now ready to compile and run the program. Before you begin, please ensure that you have a copy of HYSYS on the computer.
20. To compile the program do one of the following:
- Click the **Start** icon in the toolbar.
  - Select **Start** command from the **Run** menu.
  - Press **F5** from the keyboard.
- VB informs you of any errors that occur during compile time.



# 3 Extensibility

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## 3.1 Introduction

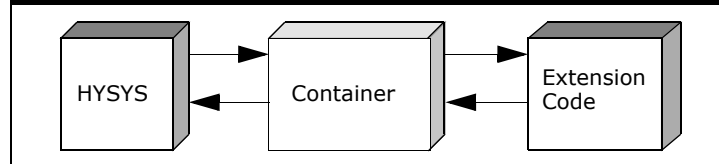
HYSYS provides the unique capability of enhancing its functionality through the addition of custom objects to a simulation. With its open concept, the functionality of HYSYS can be extended to include your unique or proprietary calculations. Currently, you can add:

- Extension Unit Operations
- Extension Reaction Kinetics
- Extension Property Packages

Extensions are packaged in to two distinct files making them easy to transfer to different machines. The extension code becomes part of a DLL (dynamic linked library), that hides its proprietary information, making it an excellent vehicle for commercial distribution. Extensions become part of the simulation and participate in simulation calculations like any other HYSYS object. For example, each extension unit operation has a corresponding PFD icon and property view. Also, the Extension has its *Execute* method called by the Steady-State Solver. Unlike applications which interact with HYSYS through Automation, extensions exist in process with the HYSYS applications. New extensions can be written in any language that supports Automation (formerly OLE Automation). This provides much flexibility to the end user, who can develop the extension in languages such as C++ or Visual Basic. By its very nature, Visual Basic provides the easiest development environment in which to create unit operation and kinetic reaction extensions. The Extension Property Package interface must be implemented as a custom interface, therefore C++ must be used.

Each type of extension is represented in HYSYS by an *Extension Container*. This object is the gateway through which HYSYS communicates with the extension. The *Container* can also provide a number of services to the extension, such as performing Mass Balances or allowing access to the Status Bar.



**Figure 3.1**

HYSYS finds extensions by looking for specific keys in the System Registry. When an extension is registered on a computer, information about it is added to the Registry. Upon start-up, HYSYS scans the Registry for this information, and adds user-specified descriptions to the appropriate lists within the program. For instance, when a unit operation extension is created with the description provided as "MY Unit Op". This text appears in the HYSYS UnitOps property view in the Available Unit Operations pane so that the user can create instances of them.

When the user asks for an extension to be created, HYSYS instantiates the object and calls its *Initialize* method. At this point, the extension code gains access to its *Container*. After the extension has been initialized, it behaves like any other HYSYS object of the same class.

All extensions must support at least two interfaces:

- The ExtensionObject interface
- At least one other interface particular to the type of extension

Containers support one interface, which is particular to the type of container.

## 3.2 Implementing Interfaces

An extension implements an interface if it supports the methods in that interface. There are two different ways of implementing an interface.

### 3.2.1 Implementing an Interface Through a Dispatch Interface

An extension can implement interfaces through Dispatch interfaces. This can be done in Visual Basic if the extension is implemented as a Visual Basic Class.

When an extension is implemented in this manner, only the methods of the interface that are required for minimal operation of the extension need be used. All other methods may be ignored, or they can be provided if the extension implements that functionality.

For example, an extension Unit Operation can be implemented by supporting only the Initialize and Execute methods. The *BasisChanged* method need only be implemented if the extension needs to be notified when the Basis of the simulation has changed.

## 3.2.2 Implementing an Interface Through a Custom Interface

An extension can also be implemented by overloading the Custom interfaces defined for the extension. For example, an extension Unit Operation can be created by overloading the ExtensionObject interface and the ExtnUnitOperation interface.

When an extension is created in this manner, all methods of the interface must be overloaded (this is a requirement of the C++ language definition). If a method does not contain any functionality, however, the error condition E\_NOTIMPL should be returned to indicate to HYSYS that the method is not being used. Using the Extension Unit Operation as an example once again; each of the methods in its two supported interfaces must be overloaded, but only the Initialize and Execute methods need return anything other than E\_NOTIMPL.

## 3.3 Data Types

This documentation for the most part uses Visual Basic syntax in its sample code and examples. The following table provides a map of Visual Basic types to C++, .NET, C#, and VB.NET types.

| Visual Basic Type | C++ Type     | .NET Type      | C# Type                                       | VB.NET Type                                   |
|-------------------|--------------|----------------|---|---|
| Variant           | VARIANT      | System.Object  | object  | Object  |
| String            | BSTR         | System.String  | string  | String  |
| Boolean           | VARIANT_BOOL | System.Boolean | bool  | Boolean                                       |
| Long              | long         | System.Int32   | int   | Integer                                       |
| Integer           | short        | System.Int16   | short   | Short   |
| Double            | double       | System.Double  | double  | Double  |
| Single            | float        | System.Single  | float   | Single  |
| arrays            | SAFEARRAY    | System.Array   | Array or specific (string[], int[], double[]) | Array or specific (string(), int(), double()) |

**When sending an array of numbers to HYSYS they should always be of type REAL or LONG.**

## 3.4 Extension Development Kit

A number of tools are provided in the HYSYS Extension Development Kit. These tools are not required to build extensions for HYSYS, but they make the job much easier. Included in the kit are the following:

| File                             | Description   |
|----------------------------------|---|
| <b>hysys.tlb</b>                 | The HYSYS Type Library, that contains definitions for all objects exposed by HYSYS, as well as definitions for interfaces required by HYSYS Extensions. Programming languages such as Visual Basic use this file to determine what a particular object contains. Many programs provide browsers to look at the contents of this file. For example, Excel provides an Object Browser that can be used to view the properties of methods of each object and to help navigate the object model. Unlike the other files in the table, the HYSYS Type Library is always installed, even when you do not install the Extension Development Kit. |
| <b>extsdk.bas</b>                | Contains constants defined by HYSYS in a format that can easily be included in a Visual Basic project. This allows the extension developer to refer to HYSYS constants through Const definitions, rather than through numbers. This information can also be read from the HYSYS Type Library, if your programming language supports this.   |
| <b>extsdk.cpp and extsdk.hpp</b> | Contain support code that can be included in a C++ project. They implement a ClassFactory for any extensions in the project and also implement the DllRegisterServer and DllUnregisterServer methods. These files compile in both Microsoft Visual C++ and Borland C++.   |
| <b>hysys.hh</b>                  | Contains definitions of all the interfaces and enumerations found in the HYSYS Type Library. Including this file in your C++ source allows you to call methods on HYSYS interfaces.   |
| <b>hysysiid.cc</b>               | Instantiates all of the GUIDs defined by HYSYS. It can be included as part of a C++ project to allow reference to HYSYS GUIDs.  |

| File   | Description  |
|--|--|
| <b>The HYSYS View Editor</b>                 | Allows you to: <ul style="list-style-type: none"><li>• Define extension information for the registration program.</li><li>• Define Variables for HYSYS to create and manage on behalf of an extension.</li><li>• Create property views for an extension.</li></ul>   |
| <b>Aspentech.<br/>HYSYS.Interop.<br/>dll</b> | <p>The HYSYS Interop Assembly contains .NET definitions for all objects exposed by HYSYS as well as definitions for interfaces required by HYSYS Extensions.</p> <p>.NET programming languages such as C# or Visual Basic use this file to determine what a particular object contains. Visual Studio provides an object browser that can be used to look at the contents of this file. Like the HYSYS Type Library, the HYSYS Interop Assembly is always installed, even when you do not install the Extension Development Kit.</p> |

## 3.5 Creating an Extension

### 3.5.1 In Visual Basic

Creating an extension in Visual Basic is a very straightforward procedure. The following six steps can be used as a general framework:

1. Create the Extension Definition.
2. Create the Object property views.
3. Implement the Required Methods.
4. Register the Extension.
5. Debug the Extension.
6. Distribute the Extension.

These steps are explained in more detail in the following sections.

### Create the Extension Definition

The EDF contains important information about an extension that is required by the extension's container in HYSYS. Specifically, it contains information about the variables that the extension own (that are managed by the container), and it can also contain one or more property views for the object.

**The extension definition file, which contains the definition of the extension is created using the View Editor.**

For each extension, you must provide either a CLSID or a ProgID. Other information that can be provided at this point includes: the extension description, from which you identify the extension within HYSYS, the extension type and the number of property views. For extensions written in Visual Basic, you must specify a ProgID. The selection of the ProgID is explained in the following sub-section entitled: [Register the Extension](#).

**It is possible to create an EDF with 0 views.**

For more information on the View Editor see [Chapter 4 - Extension View Editor](#).

Once the preliminary definition information is provided, you specify the variables that the object owns and that are visible to the user. These variables are of the following types:

| Variable Type  | Description   |
|----------------|---|
| <b>Numeric</b> | <ul style="list-style-type: none"> <li>Represent numerical quantities and have a Variable Type that allows HYSYS to manage Unit Conversions for the user.</li> <li>May have zero, one, or two dimensions.</li> <li>Can also trigger the steady state solver when they are changed. If this is the case, the variable operates like other HYSYS variables in that the solver performs consistency checking when values are changed.</li> </ul> |
| <b>Text</b>    | <ul style="list-style-type: none"> <li>Represents a string.</li> <li>May be zero- or one-dimensional.</li> </ul>  |
| <b>Message</b> | Usually associated with buttons in a property view. Messages are sent through the <i>VariableChanged</i> method of an extension.  |

Numeric Variables and Text Variables may or may not be persistent. If they are, their values are stored when the Simulation Case containing the extension is saved.

## Create the Object Property View(s)

A property view for your extension is not necessary, but quite often you want the user to be able to interact with your object. The View Editor can be used to create property views for your object.

Views are created by adding widgets to the DefaultView form. Select a widget with the secondary mouse button, drag it on to the DefaultView form, and drop it. You can then position the widget to your liking. Double-click the widget to access its Properties property view, from which you can specify detailed information for the widget. If necessary, you can associate a variable with the widget.

**A widget is an equivalent term for a Visual Basic control.**

Each DefaultView form must have a unique name. The object's default property view must be called **DefaultView** as it is the property view HYSYS attempts to open when the object is instantiated, provided the functionality of the *OnView* method is not overridden.

## Implement the Required Methods

To implement an extension from Visual Basic, you must create a project containing a Class Module. This Class Module must implement whatever methods are required by the container. For example, to implement an Extension Unit Operation, you must implement an *Initialize* method and an *Execute* method, and these methods must have the same parameters as defined by the interface.

## Register the Extension

Before you register your extension, you must ensure that the ProgID defined by your Visual Basic project is the same as that which you entered in the EDF for this object. ProgIDs are defined by Visual Basic in the following form:

`ProjectName.ClassName`

where:

*ProjectName* = the name of the project (which is set on the **Project** tab of the Options property view in VB 5.0)

*ClassName* = the name of the class (which is set through the Name parameter of the class' property view).

For Example, a class called Extension1 in a project called AspenTechExtensionProject would have a ProgID of AspenTechExtensionProject.Extension1.

For more information on extension registration see [Section 3.6 - Registering Extensions](#).

You can register extensions on the Extensions tab of the Session Preferences property view.



For more information on debugging, please consult your Visual Basic manual and help files.

## Debug the Extension

To debug the extension, you can set breakpoints on just about any line in your Visual Basic class. Initially, you should probably set a breakpoint on the *Initialize* method. Then, start the extension (via the Start button or the Start command in the Run menu).

Next, start HYSYS and create an instance of your extension. This is done in the same manner as you would create other objects of the same class. For example, extension Unit Operations can be created through the UnitOps property view (accessed through the **F12** key).

When you create an instance of your extension, HYSYS creates a container for it. This container first creates an instance of your Visual Basic class, and then calls its *Initialize* method. At this point, your breakpoint in Visual Basic should be reached. Now you can inspect variables and step through your code.

You can also use the Debug object in Visual Basic to print information to the Debug property view while the extension runs.

## Distribute the Extension

Once you are confident that your extension is behaving properly, you can create an ActiveX DLL file. Create the DLL file by selecting the appropriate option from Visual Basic's File menu. The end result of this step is an extension that you can distribute without exposing any proprietary information or methods.

To distribute your extension, you must provide the DLL file, the EDF file, and any other files required by your extension (i.e., a separate FORTRAN DLL called from your extension). You must register your extension on each individual machine that uses the extension calculations. You can use the registration tool found on the Extensions tab of the Session Preferences property view for this, or you can include this step in your own setup program.

## 3.5.2 In C++

The following six steps provide a framework for creating an extension in C++:

1. Create the Extension Definition.
2. Implement the Required Interfaces.
3. Implement the ClassFactory.
4. Create and Register the DLL.
5. Debug the Extension.
6. Distribute the Extension.

These steps are explained in more detail in the following sections.

### Create the Extension Definition

The EDF contains important information about an extension that is required by the extension's container in HYSYS. Specifically, it contains information about the variables that the extension own (that are managed by the container), and it may also contain one or more property views for the object.

**The extension definition file, which contains the definition of the extension is created using the View Editor.**

For each extension, you must provide either a CLSID or a ProgID. Other information that can be provided at this point includes: the extension description, from which you identify the extension within HYSYS, the extension type and the number of property views. The selection of the ProgID is explained in the following sub-section entitled: **Register the Extension**.

**It is possible to create an EDF with 0 views.**

For more information on the View Editor see [Chapter 4 - Extension View Editor](#).

Once the preliminary definition information is provided, you specify the variables that the object owns and that is visible to the user. These variables are of the following types:

| Variable Type  | Description   |
|----------------|---|
| <b>Numeric</b> | <ul style="list-style-type: none"> <li>Represent numerical quantities and have a Variable Type that allows HYSYS to manage Unit Conversions for the user.</li> <li>May have zero, one, or two dimensions.</li> <li>Can also trigger the steady state solver when they are changed. If this is the case, the variable operates like other HYSYS variables in that the solver performs consistency checking when values are changed.</li> </ul> |
| <b>Text</b>    | <ul style="list-style-type: none"> <li>Represents a string.</li> <li>May be zero- or one-dimensional.</li> </ul>  |
| <b>Message</b> | Usually associated with buttons in a property view. Messages are sent through the VariableChanged method of an extension.   |

Numeric Variables and Text Variables may or may not be persistent. If they are, their values are stored when the Simulation Case containing the extension is saved.

## Implement the Required Interfaces

To create an extension in C++, you must create a class that implements the required interfaces. For example, an Extension Unit Operation must implement the ExtensionObject interface and the ExtensionUnitOperation interface. This calculation can be done through inheritance or aggregation. HYSYS functions if either approach is taken, as long as the interfaces are supported through the COM QueryInterface mechanism.

To implement an extension, you must provide code for the standard COM IUnknown methods (*AddRef*, *Release*, *QueryInterface*), as well as any methods required by the interfaces you are supporting. Other methods may return E\_NOTIMPL if you choose not to implement them.

Definitions of the interfaces that you must implement (as well as any interfaces provided by HYSYS objects) are provided in the `hysys.hh` file, that is included in the Extension Development Kit. You must include this file in any source files that access the defined interfaces.

## Implement the Class Factory

When HYSYS creates an instance of your extension object, it accesses the COM Library which calls the function *DllGetObject* which is contained in the DLL. *DllGetObject* creates the requested class factory. You can implement a ClassFactory yourself, or you can use the one provided in `extsdk.cpp` (which is included in the Extension Development Kit).

If you choose to use the ClassFactory provided by `extsdk.cpp`, you must implement the `REGISTER_EXTENSION` macro somewhere in your code. This macro provides information to the ClassFactory on how to create an instance of your extension. The syntax of this macro is:

```
REGISTER_EXTENSION(ClassName, clsid, VisibleDescription)
```

where:

*ClassName* = the C++ name of the class

*clsid* = the CLSID of the class

*VisibleDescription* = a string containing a description of the class that a user can understand

You must implement this macro once for every extension in your DLL.

## Create & Register the DLL

When you build your project, you must implement it as a 32-bit Dynamic Link Library (DLL). This DLL must contain code for your extension, a ClassFactory to create your extensions, and a DllRegisterServer entry point.

The Extension Development Kit provides *extsdk.cpp*, which contains a ClassFactory and an implementation of *DllRegisterServer*. If you use this ClassFactory, you must include this file in your project.

For more information on extension registration see [Section 3.6 - Registering Extensions](#).

You can register your DLL on the Extensions tab of the Session Preferences property view.

## Debug the Extension

You can debug your extension by putting a call to the Win32 function *DebugBreak* in your code. When HYSYS executes this part of your code, you are allowed to start your debugger and debug the code from there. You are then able to inspect variables, and trace the execution of your extension's code. You can also debug your extension in MS DevStudio by setting breakpoints in the code. Specifying the path of the HYSYS executable file in the Executable for debug session field on the Debug tab of the Project Settings property view and launch VC++ auto debug.

You can load your extension by starting HYSYS and creating an instance of the extension. HYSYS creates a container, and this container then calls the extension's *Initialize* method.

## Distribute the Extension

Once you are confident that your extension is behaving properly, you can create an ActiveX DLL file. The end result of this step is an extension that you can distribute without exposing any proprietary information or methods.

To distribute your extension, you must provide the DLL file, the EDF file, and any other files required by your extension (i.e., a separate FORTRAN DLL called from you extension). You must register your extension on each individual machine that uses the extension calculations. You can use the registration tool found on the Extensions tab of the Session Preferences property view for this, or you can include this step in your own setup program.

### 3.5.3 In C# or VB.NET

Creating an extension in Visual Basic is a very straightforward procedure. The following six steps can be used as a general framework:

1. Create the Extension Definition.
2. Create the Object property views.
3. Implement the Required Methods.
4. Register the Extension.
5. Debug the Extension.
6. Distribute the Extension.

These steps are explained in more detail in the following sections.

## Create the Extension Definition

The EDF contains important information about an extension that is required by the extension's container in HYSYS. Specifically, it contains information about the variables that the extension own (that are managed by the container), and it may also contain one or more property views for the object.

**The extension definition file, which contains the definition of the extension is created using the View Editor.**

For each extension, you must provide either a CLSID or a ProgID. Other information that can be provided at this point includes: the extension description, from which you identify the extension within HYSYS, the extension type and the number of

property views. The selection of the ProgID is explained in the following sub-section entitled: **Register the Extension**.

**It is possible to create an EDF with 0 views.**

Once the preliminary definition information is provided, you specify the variables that the object owns and that are visible to the user. These variables are of the following types:

| Variable Type  | Description   |
|----------------|---|
| <b>Numeric</b> | <ul style="list-style-type: none"> <li>• Represent numerical quantities and have a Variable Type that allows HYSYS to manage Unit Conversions for the user.</li> <li>• May have zero, one, or two dimensions.</li> <li>• Can also trigger the steady state solver when they are changed. If this is the case, the variable operates like other HYSYS variables in that the solver performs consistency checking when values are changed.</li> </ul> |
| <b>Text</b>    | <ul style="list-style-type: none"> <li>• Represents a string.</li> <li>• May be zero- or one-dimensional.</li> </ul>  |
| <b>Message</b> | Usually associated with buttons in a property view. Messages are sent through the <i>VariableChanged</i> method of an extension.  |

Numeric Variables and Text Variables may or may not be persistent. If they are, their values are stored when the Simulation Case containing the extension is saved.

## Create the Object Property View(s)

A property view for your extension is not necessary, but quite often you want the user to be able to interact with your object. The View Editor can be used to create property views for your object.

Views are created by adding widgets to the DefaultView form. Select a widget with the secondary mouse button, drag it onto the DefaultView form, and drop it. You can then position the widget to your liking. Double-click the widget to access its Properties property view, from which you can specify detailed information for the widget. If necessary, you can associate a

variable with the widget.

**A widget is an equivalent term for a control.**

Each DefaultView form must have a unique name. The object's default property view must be called **DefaultView** as it is the property view HYSYS attempts to open when the object is instantiated, provided the functionality of the *OnView* method is not overridden.

## Implement the Required Methods

To implement an extension in C# or VB.NET, you must first create a Class Library project. In the project, you must then add a reference to the HYSYS Interoperability Library (Aspentech.HYSYS.Interop.dll) which can be found in the root directory of the install location for Aspen HYSYS 2006.

Next, you must create a class that implements the required interfaces. For example, an Extension Unit Operation must implement the ExtensionObject interface and the ExtensionUnitOperation interface.

The class should have the appropriate attributes from the **System.Runtime.InteropServices** namespace required to export a class to COM. These include but are not limited to **ComVisible**, **ClassInterface**, **GuidAttribute**, and **ProgIdAttribute**. **ComVisible** must be set to true; **ClassInterface** is recommend to be set to AutoDispatch which is the default; **GuidAttribute** represents the CLSID and will be generated if not specified (its highly recommended that you specify this manually); **ProgIdAttribute** is optional unless you refer to this class using the ProgID in the Extension Definition.

## Register the Extension

You can register extensions on the Extensions tab of the Session Preferences property view or using the regextn.exe command-line executable.

For more information on extension registration see [Section 3.6 - Registering Extensions](#).



## Debug the Extension

To debug the extension, you can set breakpoints on just about any line in your class. Initially, you should probably set a breakpoint on the Initialize method. Then, set HYSYS.exe as the external program in the Project Properties Debug page.

You can debug your extension in Microsoft Visual Studio 2003 or 2005 by setting breakpoints in the code and by attaching to running copy of HYSYS from the Attach to Process dialog from the Tool menu. When attaching the extension to a running HYSYS case, ensure that you select the managed code debug option and not native code debug option. You can also start HYSYS from Microsoft Visual Studio by specifying the path of the HYSYS executable file in the Start external program field on the Debug tab of the Project Settings property view.

You can load your extension by starting HYSYS and creating an instance of the extension. HYSYS creates a container, and this container then calls the Initialize method of that extension. You can also use the **System.Diagnostics.Debug.Print** method in .NET to print information to the Output Debug view while the extension runs.

**Note:** Microsoft Visual Studio .NET 2003 cannot debug a managed process if .NET 2.0 is being used (HYSYS uses .NET 2.0 by default). You can override this behaviour and force .NET 1.1 to be used so that Visual Studio .NET 2003 can debug the extension by adding a file called **hysys.exe.config** to same directory as hysys.exe that states:

```
<configuration>
  <startup>
    <requiredRuntime version="v1.1.4322"/>
  </startup>
</configuration>
```

## Distribute the Extension

Once you are confident that your extension is behaving properly, you can create an ActiveX DLL file. The end result of this step is an extension that you can distribute without exposing any

proprietary information or methods.

To distribute your extension, you must provide the DLL file, the EDF file, and any other files required by your extension (i.e., a separate FORTRAN DLL called from you extension). You must register your extension on each individual machine that uses the extension calculations. You can use the registration tool found on the Extensions tab of the Session Preferences property view for this, or you can include this step in your own setup program.

## 3.6 Registering Extensions

In order for HYSYS to find extensions, they must be registered in the Extensions tab of the Session Preferences property view. HYSYS looks for extensions in the:

```
HKEY_CLASSES_ROOT\Software\AspenTech\HYSYS\1.1\Extensions key.
```

Each extension should have the following information under this key:

**KeyName = *Descriptive Name of Extension***  
**ExtensionDefinitionFile = *name of Extension Definition File***  
**ExtensionType = *type, class***  
**CLSID = *CLSID of Extension or***  
**ProgID = *ProgID of Extension***

See [Chapter 4 - Extension View Editor](#) for more information on creating an EDF.

All this information is provided when the EDF is created in the View Editor.

Extensions can be registered with either a CLSID (Class Identifier) or a ProgID (Program Identifier). It is recommended that ProgID be used for extensions created in Visual Basic, and CLSID be used for all other extensions.

**Only one of the ProgID or CLSID values can be used.**

The Extension Definition File entry gives the name of the

Extension Definition File for the object.

The type of the extension is given by the `ExtensionType` entry. The type can be `UnitOperation`, `PropertyPackage` or `KineticReaction`. The class descriptor is optional, and currently is ignored if present.

## 3.6.1 Registering Extensions Written in C++

When you create an extension in C++, you must implement a *DllRegisterServer* function in the DLL containing the extension. This function is called from HYSYS when registering the extension. The file **extsdk.cpp** that is included with the Extension Development Kit provides code that implements this function.

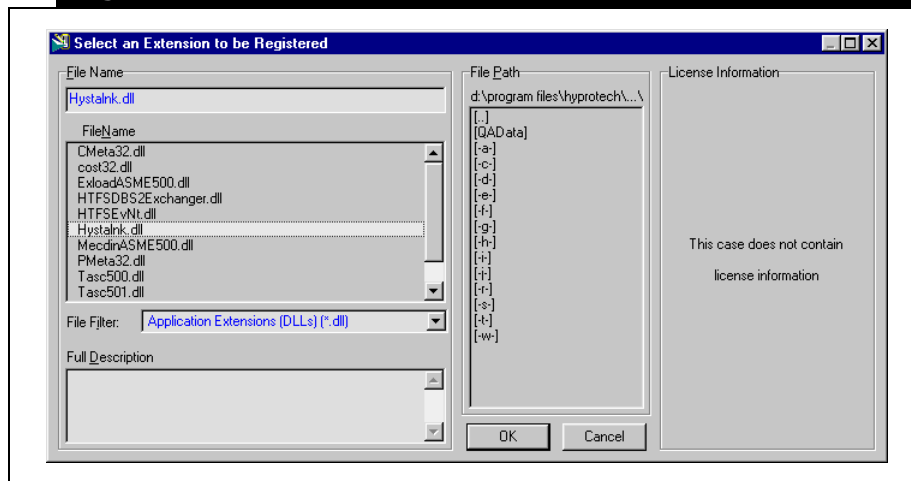
**Ensure that the EDF and extension DLL are in the same directory.**

To register an extension written in C++, simply use the following procedure:

1. Start HYSYS. From the **Tools** menu, select **Preferences** command. The Session Preferences property view opens.
2. Go to the **Extensions** tab and click the **Register an Extension** button. This opens the **Select an Extension to be Registered** property view.

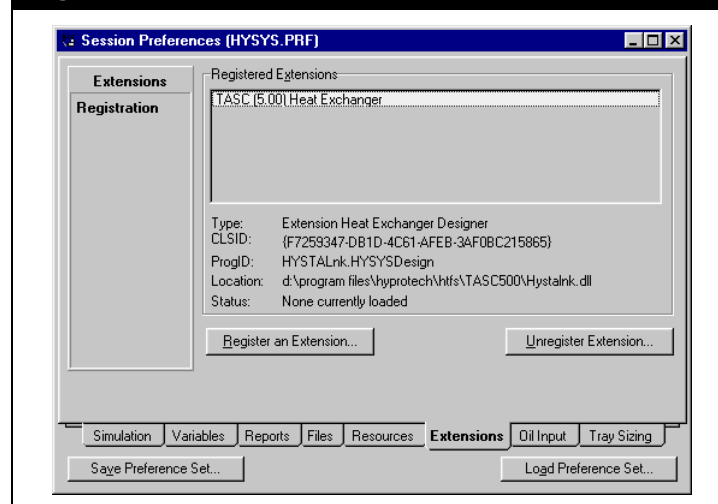
3. Use the **File Path** group to find the directory in which the DLL file is saved. Once you find the DLL file, select it and click the **OK** button.

Figure 3.2



The Extensions tab should now appear similar to the figure below.

Figure 3.3



You are now ready to use the extension in HYSYS.

## 3.6.2 Registering Extensions Written in Visual Basic

Refer to [Section 3.6.1 - Registering Extensions Written in C++](#), for the step by step procedure for registering HYSYS extensions.

Extensions written in Visual Basic may be run from within Visual Basic, or may be compiled to an ActiveX DLL file. Either way, Visual Basic takes care of registering half of the information required for HYSYS to find the extension. The HYSYS registration tool provided in the Session Preferences property view may be used to register the other half.

### Running Within Visual Basic

If you are running your extension within the Visual Basic environment, Visual Basic temporarily adds information to the registry every time the project is run. This information changes every time you run the project. The extra information needed can be added by going to the Extensions tab of the Session Preferences property view and registering the EDF file. When run this way, information about where to find an extension is added to the registry, but information on how to create it is not.

**To view EDF files in Select an Extension to be Registered property view, you must change the settings in the File Filter drop-down list from Application Extensions (\*.dll) to Extension Definition Files (\*.edf).**

### Compiled DLL Files

When you compile your extension to an ActiveX DLL file, you must do both parts of the registration. You can use the procedure described in the [Section 3.6.1 - Registering Extensions Written in C++](#) to register the DLL files in the HYSYS Session Preferences.

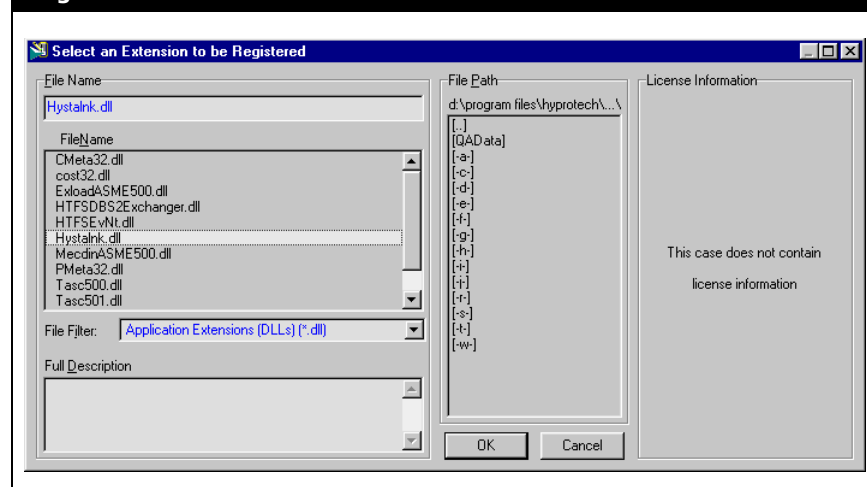
HYSYS loads the DLL file and registers it, and then it takes the name of the DLL file and looks for an Extension Definition File with the same name in the same directory to complete the registration.

## 3.6.3 Registering Extensions Written in C# or VB.NET

To register an extension written in C# or VB.NET, use the following procedure:

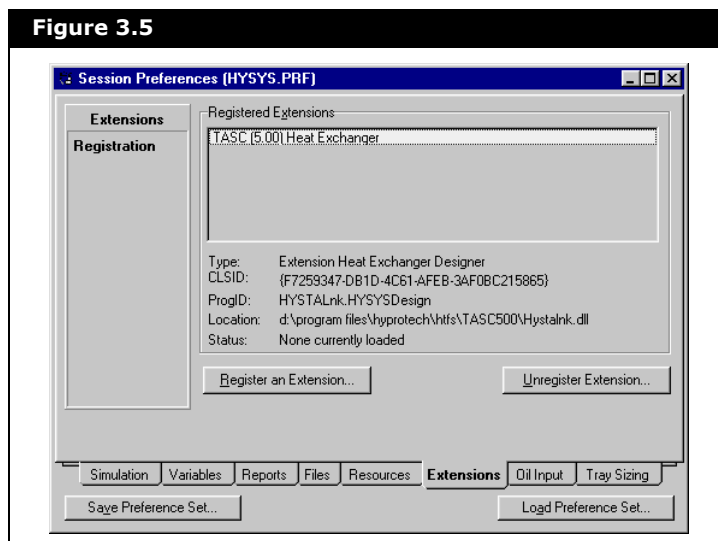
1. Start HYSYS. From the **Tools** menu, select **Preferences** command. The Session Preferences property view opens.
2. Go to the **Extensions** tab and click the **Register an Extension** button. This opens the **Select an Extension to be Registered** property view.
3. Use the **File Path** group to find the directory in which the DLL file is saved. Once you find the DLL file, select it and click the **OK** button.

Figure 3.4



The Extensions tab should now appear similar to the figure

below.



You are now ready to use the extension in HYSYS.

## 3.7 Extension Interface Details

Three types of extensions can currently be created for use within HYSYS:

- Unit Operations
- Kinetic Reactions
- Property Packages

Each extension type is associated with a unique container interface derived from the ExtnContainer object. For instance Unit Operation Extensions have an ExtnUnitOperation interface.

### 3.7.1 ExtnContainer Interface

Each type of extension has a unique container associated with it. Each container implements an interface that provides methods

and properties for the extension.

| Derived from | Properties  | Methods   |
|--------------|---|---|
| IDispatch    | <ul style="list-style-type: none"><li>• ExtensionInterface</li><li>• FPStatus</li><li>• OnOleEnabledThread</li><li>• SimulationCase</li><li>• StatusBar</li></ul> | <ul style="list-style-type: none"><li>• ClearStatusBar</li><li>• FindVariable</li><li>• OpenContainerStorage</li><li>• OpenView</li><li>• Trace</li><li>• WaitForTurn</li></ul> |



## 3.7.2 ExtensionObject Interface

Every extension must implement the ExtensionObject interface. This interface defines methods that are common to all HYSYS extensions. No methods in this interface are mandatory; that is, all methods may be ignored if the extension does not implement them.

| Derived from | Properties | Methods   |
|--------------|------------|---|
| IDispatch    | none       | <ul style="list-style-type: none"> <li>• OnHelp</li> <li>• Save</li> <li>• StatusQuery</li> <li>• Terminate</li> <li>• VariableChanged</li> <li>• VariableChanging</li> </ul> |

## 3.8 Extension Reaction Kinetics

You can add your own Reaction Kinetics expressions to HYSYS through the Reaction Kinetics Extension. These extensions appear to the user like any other HYSYS reaction type. Additionally, you can specify which components partake in the expression, as well as define new properties for the reactants.

To implement an extension Kinetic Reaction, you must implement two interfaces

| Interface                  | Description  |
|----------------------------|--|
| <b>ExtensionObject</b>     | Called when reaction extension is added to the simulation. |
| <b>ExtnKineticReaction</b> | Called when the reaction extension is used.                |

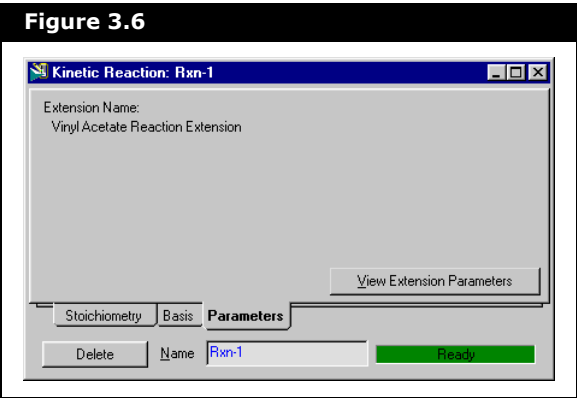
The container for the extension supports the ExtnKineticReactionContainer interface. This acts as the interface to all the widgets and variables in the HYSYS standard kinetic reaction property view.

These previously described interfaces allow a reaction to be implemented and associated with a HYSYS case through a fluid package. The Reaction Extension also requires the definition of two methods in order for the extension to be viable:

| Method              | Description   | Details   |
|---------------------|---|---|
| <b>Initialize</b>   | The Initialize method is called whenever the extension is first added or whenever a case containing the extension is reopened. This is also the procedure where you would usually set the state of the properties and define the reactants used.  | <b>ByVal Container as ExtnUnitOperationContainer</b><br>The kinetic reaction container object.  |
|                     |   | <b>ByVal IsRecalling as Boolean</b><br>Value related to the state of the extension. False if created for the first time. True if there is an existing extension.          |
|                     |   | <b>Initialize as Long (Return Value)</b><br>Return value must be the current HYSYS build. A constant extnCurrentVersion is provided in the type library for this purpose. |
| <b>ReactionRate</b> | Called when the reaction extension is used. The method is a function that returns true when successful and false if an error occurs. The calculation involves returning a rate value through the 'Rate' argument while the HYSYS solver iteratively calls the <i>ReactionRate</i> method. | <b>ByVal hyFluid as Fluid</b><br>Fluid based on the input stream to the operation.  |
|                     |   | <b>ByVal RxnTemperatureInC as Double</b><br>Reaction Temperature in HYSYS internal units of Celsius.  |
|                     |   | <b>ByVal RxnVolumeInKmolPerM3 as Double</b><br>Reaction volume in HYSYS internal units of cubic meters.   |
|                     |   | <b>Rate as Double</b><br>Rate value, passed by reference, so its value can manipulated and permanently altered within the method.   |
|                     |   | <b>ReactionRate as Boolean</b><br>True if rate could be calculated, False if there is an error.   |

## Extension Definition Files

An extension definition file is required for the kinetic reaction extension. Since HYSYS uses a specific interface for reaction extensions, the property view within the EDF is not the primary property view when the extension is accessed in HYSYS. If you do create a customized property view in the View Editor, you can access it through the **View Extension Parameters** button found on the Parameters tab.



### 3.8.1 ExtnKineticReaction Interface

The ExtnKineticReaction interface must be implemented by all extension kinetic reactions. In addition to the *Initialize* and *Reaction Rate* methods which are mandatory, the interface also has the following associated properties and methods:

| Derived from | Properties | Methods  |
|--------------|------------|--|
| IUnknown     | IsReady    | <ul style="list-style-type: none"><li>• BasisChanged</li><li>• ReactionRate2</li></ul> |

## 3.8.2 ExtnKineticReactionContainer Interface

The ExtnKineticReactionContainer interface is passed to an extension Kinetic Reaction in its *Initialize* method.

| Derived from  | Properties   | Methods   |
|---------------|--|---|
| ExtnContainer | <ul style="list-style-type: none"> <li>• BaseReactant</li> <li>• BasisConversion</li> <li>• MaxTemperature</li> <li>• MinTemperature</li> <li>• Phase</li> <li>• RateConversion</li> <li>• Reactants</li> <li>• ReactionBasis</li> </ul> | <ul style="list-style-type: none"> <li>• AddReactantProperty</li> <li>• RemoveReactantProperty</li> <li>• SetReactionPropertyState</li> </ul> |

## 3.8.3 Kinetic Reaction Example

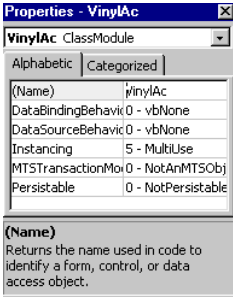
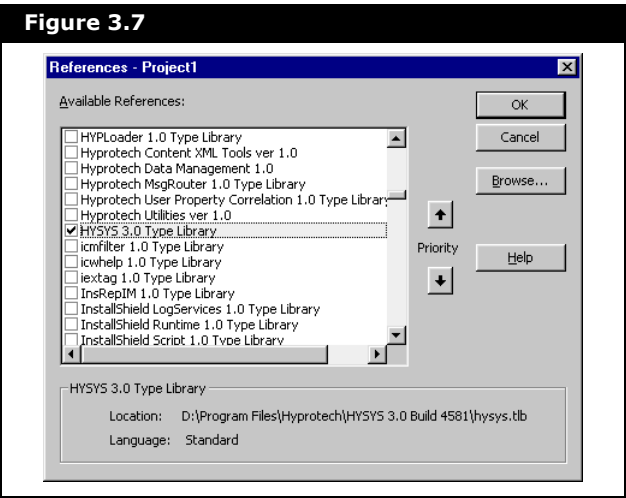
In this example, you use Visual Basic 5.0 to build a reaction kinetics extension for a reaction involving vinyl acetate.

1. Create a new project in Visual Basic 5.0 from the **New** tab of the New Project property view.
2. Select the **ActiveX.DLL** icon as the project type and click the **Open** button.



ActiveXDLL icon

- 3. Make sure that the **HYSYS 3.\* Type Library** checkbox is selected in the References property view, which is accessed by selecting the **References** command from the **Project** menu.



Properties property view

- 4. In the Properties tiled property view, ensure that the **Instancing** drop-down list is set to **5-MultiUse**.
- 5. In the Properties tiled property view, rename the class module **VinylAc**.
- 6. Save the class and project by selecting **Save Project** command from the **File** menu. Save the class and project as **VinylAc.cls** and **VinylAc.vbp**
- 7. You are now ready to define the class. Begin by defining the global variables in the Project VinylAc Code property view:

| Code  | Explanation   |
|---|---|
| <b>Option Explicit</b>  | Used to force explicit declaration of all variables in that module.   |
| <pre>Dim hyContainer As Object Dim hyBulkDens As Object</pre> | Declare the global HYSYS objects. The <b>hy</b> prefix is a convention to identify variables which come from HYSYS. |

8. The first function declared is the *Initialize* function. It is called when the extension is first added to HYSYS or when a case containing the extension is loaded.

| Code   | Explanation   |
|--|---|
| <b>Public Function Initialize(ByVal Container As Object, ByVal IsRecalling As Boolean) As Long</b>   | Initialize is called when the extension is first added to the simulation or when a simulation case containing the extension is loaded.  |
| On Error GoTo ErrorTrap  | Enable Error trapping.  |
| Dim hyReactant As Reactant   | Declare KineticReactionContainer variable.  |
| Initialize = extnCurrentVersion  | Reference the current HYSYS version   |
| Set hyContainer = Container  | This reference lets the extension interact with HYSYS through the extension container, the <b>ExtnKineticReactionContainer</b> object. Methods from the ExtensionObject object are also available.  |
| Set hyBulkDens =<br>hyContainer.FindVariable("BulkDens").Variable  | Set an object reference to the <b>BulkDens</b> variable, which is created in the EDF file.  |
| If IsRecalling = False Then<br>hyBulkDens.Value = 2700   | The variable <b>IsRecalling</b> is only <b>False</b> when the extension is first added to the simulation. This sets a default for BulkDens (2700 kg catalyst/m <sup>3</sup> reactor volume).  |
| hyContainer.Phase = ptVapourPhase<br>hyContainer.ReactionBasis =<br>rbPartialPressBasis  | Setting the remaining reaction properties (usually found on the <b>Basis</b> tab of the Reaction property view). The <b>Phase</b> of the reaction is to be <b>Vapour</b> and the reaction <b>Basis</b> is to be <b>Partial Pressure</b> . |
| hyContainer.Reactants.RemoveAll  | This initializes the reactants list by removing any reactants that may be specified.  |
| Set hyReactant =<br>hyContainer.Reactants.Add("Ethylene")<br>hyReactant.StoichiometricCoefficientValue = -1<br>hyContainer.BaseReactant = hyReactant | Adds the component <b>Ethylene</b> as a Reactant. It sets the stoichiometric coefficient of ethylene as <b>-1</b> (i.e., 1 mole of ethylene being consumed). You are also specifying ethylene to be the base reactant.                    |

| Code  | Explanation   |
|---|---|
| <pre> Set hyReactant = hyContainer.Reactants.Add("AceticAcid") hyReactant.StoichiometricCoefficientValue = -1 Set hyReactant = hyContainer.Reactants.Add("Oxygen") hyReactant.StoichiometricCoefficientValue = -0.5 Set hyReactant = hyContainer.Reactants.Add("VinylAcetate") hyReactant.StoichiometricCoefficientValue = 1 Set hyReactant = hyContainer.Reactants.Add("H2O") hyReactant.StoichiometricCoefficientValue = 1  hyContainer.BasisConversion = "psia"  With hyContainer .SetReactionPropertyState rpReactants, vsCalculated .SetReactionPropertyState rpStoichiometricCoefficients, vsCalculated .SetReactionPropertyState rpMinTemperature, vsCalculated .SetReactionPropertyState rpMaxTemperature, vsCalculated .SetReactionPropertyState rpReactionBasis, vsCalculated .SetReactionPropertyState rpReactionPhase, vsCalculated .SetReactionPropertyState rpBaseReactant, vsCalculated .SetReactionPropertyState rpBasisConversion, vsCalculated .SetReactionPropertyState rpRateConversion, vsCalculated End With End If ErrorTrap: </pre> | <p>Adds the remaining components and specifies their stoichiometric coefficients.</p>   |
|   | <p>Sets the Basis Conversion units to psia. The Rate Conversion units is left in HYSYS internal units of kg mole/m<sup>3</sup>-s.</p>   |
|   | <p>Sets the property states as Calculated so that they cannot be modified. The <b>With</b> statement is used for efficiency since each line uses the <b>SetReactionPropertyState</b> method of the <b>hyContainer</b> object.</p> |
|   | <p>Line to which the On Error statement branches if an error occurs</p>   |
| <b>End Function</b>   | <p>Signifies the end of the function. This line does not need to be added.</p>  |

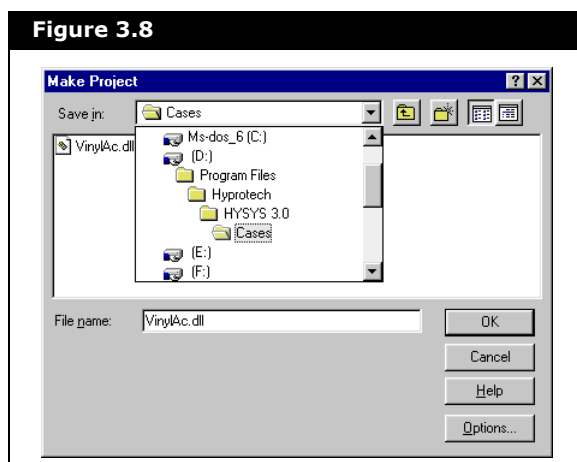
9. The other function that is required to implement a kinetic reaction extension is the *ReactionRate* function.

| Code   | Explanation   |
|--|---|
| <b>Public Function ReactionRate(ByVal Fluid As Object, ByVal RxnTemperatureInC As Double, ByVal RxnVolumeInKmolPerM3 As Double, rate As Double) As Boolean</b>   | This function is called whenever the extension is executed.   |
| On Error GoTo ErrorTrap  | Enable Error trapping.  |
| Dim TotalPressure As Double<br>Dim RxnTemperatureinK As Double<br>Dim EthyleneIndex As Integer<br>Dim AceticAcidIndex As Integer<br>Dim OxygenIndex As Integer<br>Dim WaterIndex As Integer<br>Dim ComponentFrac As Variant<br>Dim EthylenePP As Double<br>Dim AceticAcidPP As Double<br>Dim OxygenPP As Double<br>Dim WaterPP As Double | Declare local variables.  |
| If hyBulkDens.Value <= 0 Then<br>hyBulkDens.Value = 2700   | Check to see if the value of hyBulkDens > 0. If not, then sets it to the default value of 2700 kg catalyst/m <sup>3</sup> reactor volume. |
| TotalPressure =<br>Fluid.Pressure.GetValue("psia")   | Gets the overall pressure of the reaction in psia.  |
| RxnTemperatureinK = RxnTemperatureInC +<br>273.15  | Get the temperature of the reaction K.  |
| EthyleneIndex =<br>Fluid.Components.Index("Ethylene")<br>AceticAcidIndex =<br>Fluid.Components.Index("AceticAcid")<br>OxygenIndex =<br>Fluid.Components.Index("Oxygen")<br>WaterIndex = Fluid.Components.Index("H2O")<br>ComponentFrac = Fluid.MolarFractionsValue   | Get component index numbers. These index numbers are later used to reference the components and their properties.                         |
|  | Set <b>ComponentFrac</b> equal to the component molar fractions of the fluid.   |
| EthylenePP = ComponentFrac(EthyleneIndex) *<br>TotalPressure<br>AceticAcidPP =<br>ComponentFrac(AceticAcidIndex) *<br>TotalPressure<br>OxygenPP = ComponentFrac(OxygenIndex) *<br>TotalPressure<br>WaterPP = ComponentFrac(WaterIndex) *<br>TotalPressure  | Get partial pressure of components in psia by multiplying component mole fraction by total pressure (Smith and Van Ness, p. 300).         |



| Code   | Explanation   |
|--|---|
| <pre>rate = 0.1036 * Exp(-3674 / RxnTemperatureinK) * OxygenPP * EthylenePP * AceticAcidPP * (1 + 1.7 * WaterPP) / ((1 + 0.583 * OxygenPP * (1 + 1.7 * WaterPP)) * (1 + 6.8 * AceticAcidPP)) * hyBulkDens.Value * 1000</pre> | Calculate the reaction rate <sup>1</sup> . The rate is in g mol AceticAcid consumed/min-g catalyst. <b>hyBulkDens.Value</b> is multiplied by <b>1000</b> to convert it to <b>g catalyst/m<sup>3</sup></b> reactor volume. |
| <pre>rate = rate / 1000 / 60</pre>   | Since the units required by HYSYS are kg mole/m <sup>3</sup> -s, divide by <b>1000</b> g mol/kg mol and divide by <b>60</b> s/min.  |
| <pre>ReactionRate = True</pre>   | Tell HYSYS that the calculation worked as expected.   |
| <pre>ErrorTrap:</pre>  | Line to which the On Error statement branches if an error occurs.   |
| <b>End Function</b>  | Signifies the end of the function. This line does not need to be added.   |

10. Select **Make VinylAc.dll** command from the **File** menu. The Make Project property view appears.



11. Select the folder you want to save the VinylAc.dll file in, and click the **OK** button.

## Creating the Extension Definition File (EDF)

In order to complete the Kinetic Reaction Extension, you must create an EDF. This is done through the Extension View Editor.

For more information on installing and accessing the View Editor, see [Section 4.1.1 - Accessing the View Editor](#).



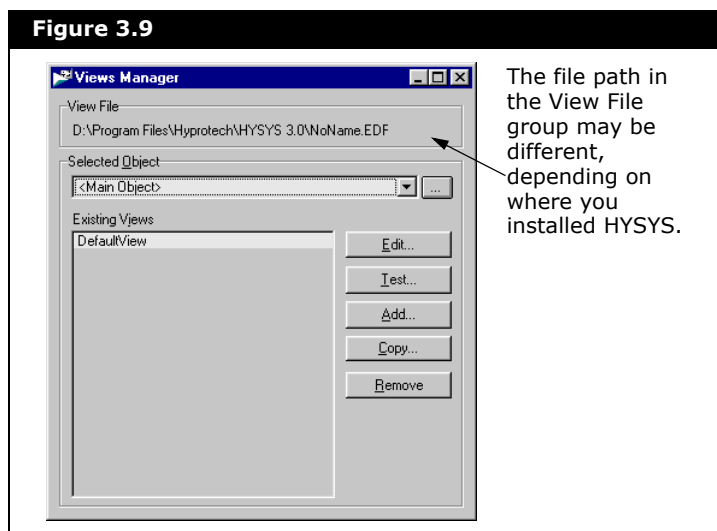
New File icon

**If it has been installed, the Extension View Editor is found in the same launch point in the Start menu as HYSYS.**

1. Open the Extension View Editor and open a new EDF by doing one of the following:
  - Select **New** command under the **File** menu in the menu bar
  - Use the hot key combination **CTRL N**
  - Click the **New File** icon

The default View Manager property view appears as shown below:

**Figure 3.9**

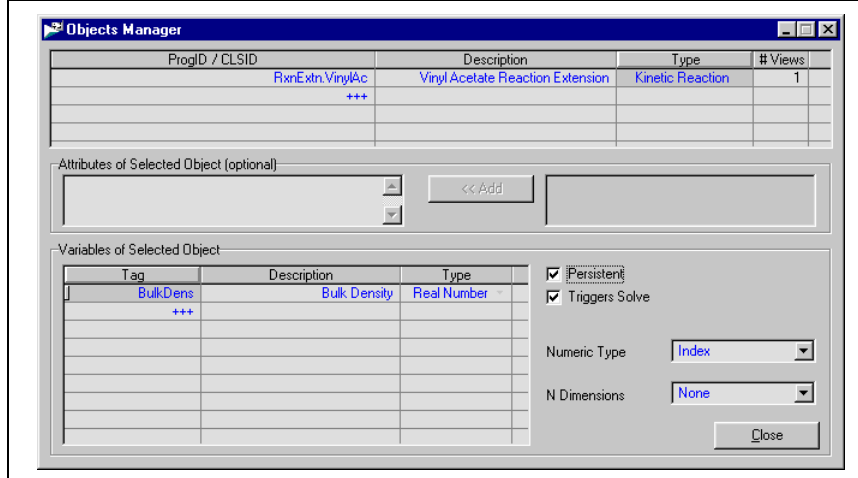


Objects Manager icon

2. Click the **Objects Manager** icon to open the Objects Manager property view.
3. In the ProgID/CLSID field enter **RxnExtn.VinylAc** as the extension ID.
4. Enter an appropriate description for the extension in the Description field, such as **Vinyl Acetate Reaction Extension** as shown in [Figure 3.10](#).

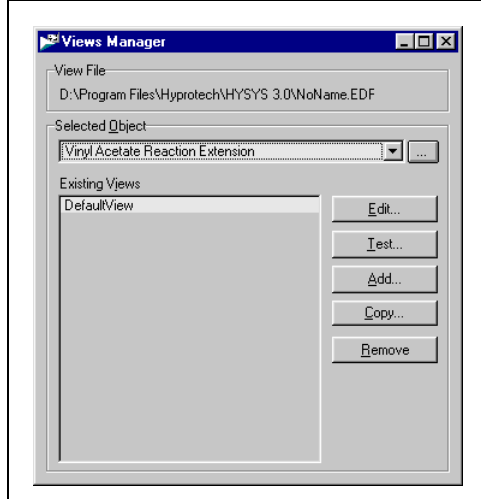
5. Select **Kinetic Reaction** as extension type in the Type drop-down list.
6. Specify the information in the Variables of Selected Object group as shown below, and select the **Persistent** checkbox.

Figure 3.10

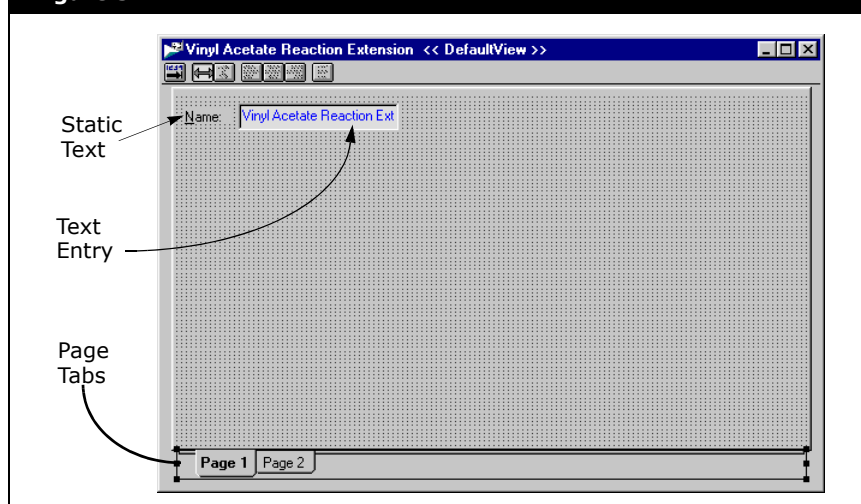


7. Click the **Close** button. This returns you to the Views Manager property view.

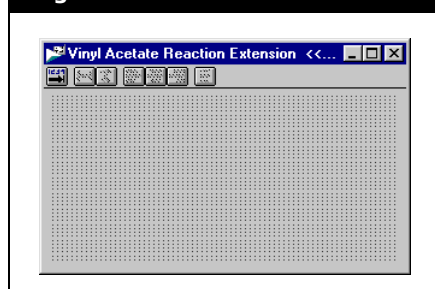
Figure 3.11



8. From the Existing Views list, select the DefaultView and click the **Edit** button. The DefaultView form appears. It consists of several default objects that are not used in this example. These objects have to be deleted.
9. Begin by deleting the **Page Tabs** widget. Select the tabs found at the bottom of the DefaultView form as shown below and press the **DELETE** key.

**Figure 3.12**

10. Delete the Name **Static Text** widget and the Object Name **Text Entry** widget using the method described in the step above.
11. Resize the DefaultView form into a smaller property view, as shown below.

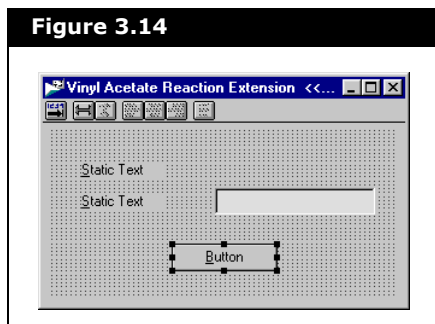
**Figure 3.13**

### Adding Widgets to the DefaultView form

1. From the Widgets Palette select a **Numerical Input** widget.
2. Right-click, hold, and drag the widget into the DefaultView form.
3. When you find an appropriate part of the property view to place the widget, release the mouse button and the widget should *drop* into place.

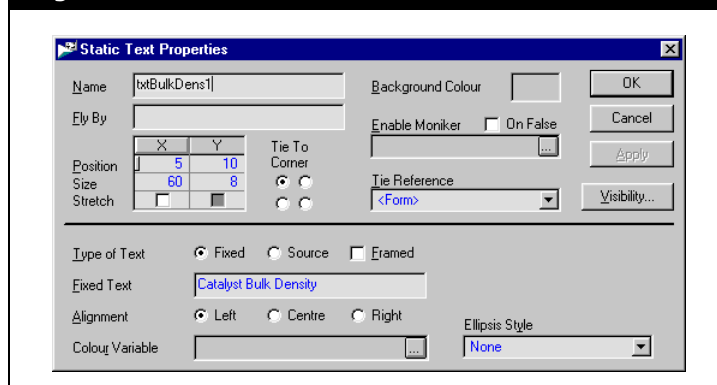
Use the drag and drop method described in the above steps to add the two **Static Text** widgets and a **Button** widget as shown below.

**Figure 3.14**

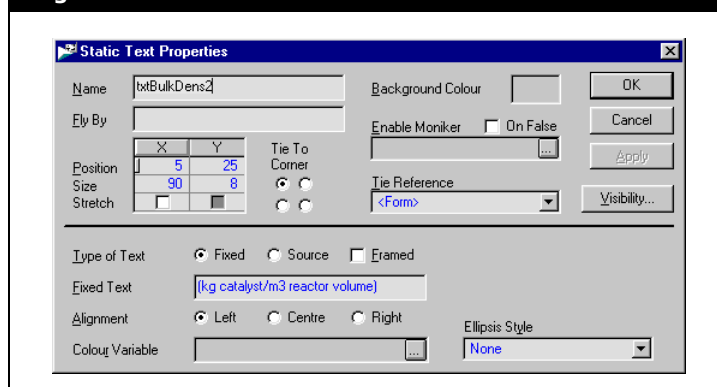


4. Now the widgets must be defined. To open a widget's properties do one of the following:
  - Double-click on the widget
  - Right-click the widget and select **<Widget Type> Properties** command from the Object Inspect menu, where *Widget Type* would be *Button* for a Button widget.

5. For the upper Static Text widget specify properties as shown below. When you are finished click the **OK** button.

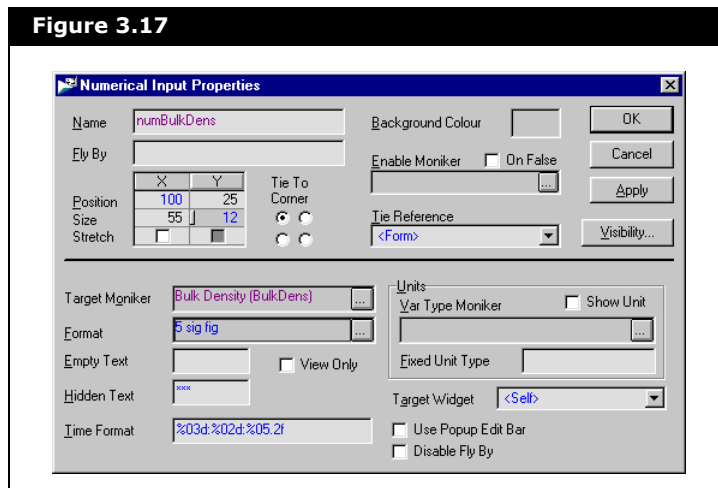
**Figure 3.15**


6. For the lower Static Text widget specify properties as shown below. When you are finished click the **OK** button.


**Figure 3.16**

7. For the Numerical Input widget specify properties as shown below. When you are finished click the **OK** button.

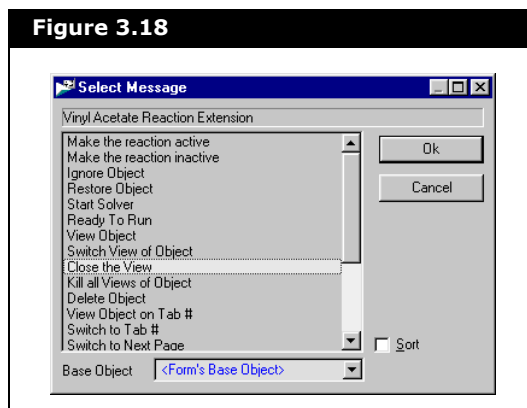
Figure 3.17



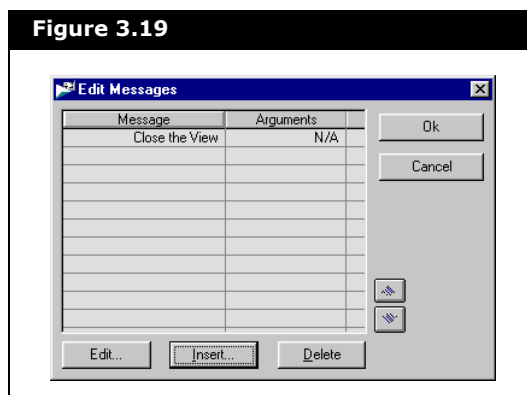
The **Target Moniker** field is specified by clicking the **Ellipsis** icon  associated with the field and selecting **Bulk Density** from the Select Number Variable property view.

8. Open the Properties property view of the Button widget.
9. In the Label field specify the button label as **&Close** where the **&** indicates the hot key underscore designation (in other words, pressing **ALT +** hot key brings focus to this object).
10. Click the **Ellipsis** icon  associated with the Message field to open the Edit Messages property view.

11. Click the **Insert** button on the Edit Messages property view. The Select Message property view appears. Select the **Close the View** message from the list.

**Figure 3.18**

12. Click the **OK** button to add this message to this button. The Edit Messages property view appears as shown below.

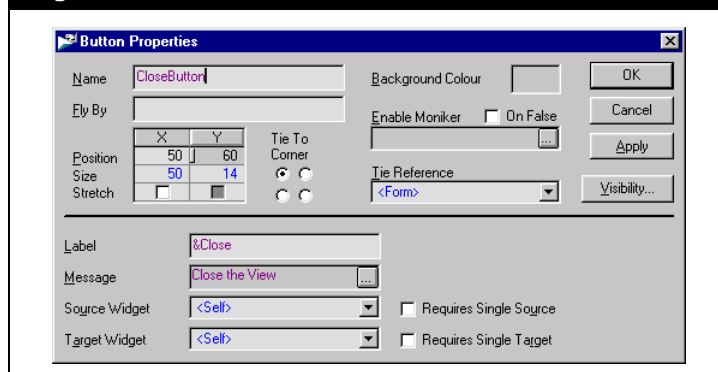
**Figure 3.19**

13. Click the **OK** button on the Edit Messages property view to close this property view and return to the Button Properties property view.



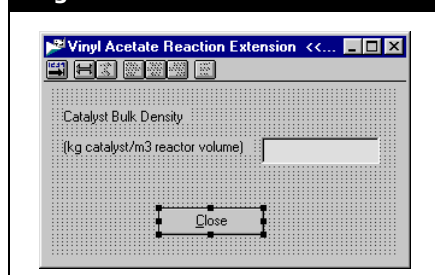
14. Specify the Name field as shown below. When you are finished click the **OK** button.

Figure 3.20



The property view now appears as shown below.

Figure 3.21



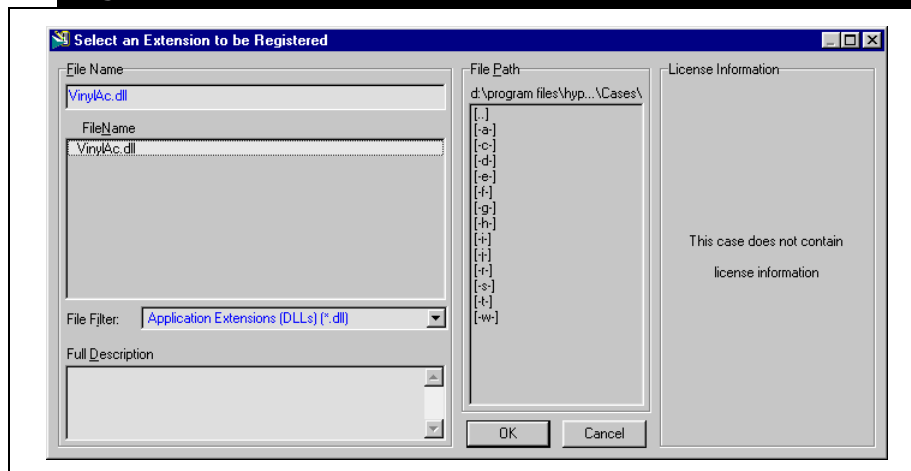
15. Select **Save** command from the **File** menu and save the EDF file as "VinylAc.edf" in the **same** directory as the DLL file.

## Attaching the Extension to HYSYS

You are now ready to attach the extension to HYSYS. The following steps demonstrate how to attach an extension within HYSYS.

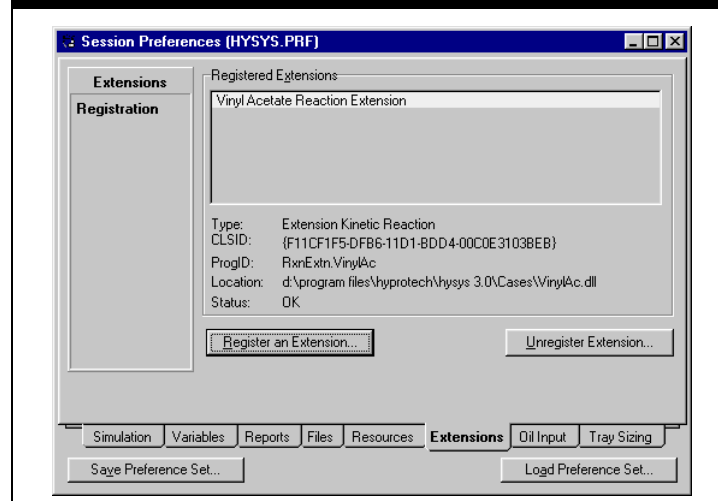
1. Start HYSYS. From the **Tools** menu, select **Preferences** command. The Session Preferences property view appears.
2. Go to the **Extensions** tab and click the **Register an Extension** button. The Select an Extension to be Registered property view appears.

3. Use the File Path group to find the directory in which the **VinylAc.dll** file is saved in. Once you find the DLL file, select it and click the **OK** button.

**Figure 3.22**

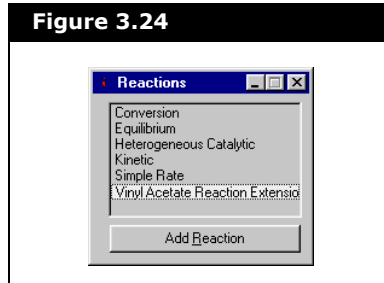
4. The HYSYS Extension Registration property view appears and displays whether the registration was successful or not. Click the **OK** button to close the property view.

The Extensions tab should now appear similar to the figure below.

**Figure 3.23**

5. You can now go to the **Reactions** tab of the Simulation Basis Manager property view and add a **VinylAcetate Reaction Extension** from the Reactions property view.

Figure 3.24



## 3.9 Extension Property Packages

You can put your own physical property calculations into HYSYS as an Extension Property Package, which appears to the user as any other property package in the program.

HYSYS makes calls to property packages under a number of different situations. Calls are made in both Steady State and Dynamics mode.

To implement an Extension Property Package, you must implement two interfaces:

| Interface                  | Description  |
|----------------------------|--|
| <b>ExtensionObject</b>     | Called when the property package extension is added to the simulation. |
| <b>ExtnPropertyPackage</b> | Called when the property package extension is used.                    |

Many different methods must be supported by Extension Property Packages; however, depending on what functionality is supported, certain methods may be left unimplemented. The extension must let its container know which features it supports through the ExtensionPPkgInit structure passed to the extension in its *Initialize* method.

The `ExtnPropertyPackage` interface is not a dual interface; for efficiency, non-ActiveX Automation compatible data types are passed as parameters. This means that Extension Property Packages cannot be easily written in Visual Basic, and cannot be implemented as Local Servers.

## Initialization

When an Extension Property Package is initialized, it must fill in the *ExtensionPPkgInit* structure passed to it by its container. This structure lets the container know which features the extension supports, such as requirements for a component slate and whether or not the property package can handle changes to the component slate order.

An Extension Property Packages can be as simple as a steam table, or as complex as an activity model or equation of state package. HYSYS behaves differently for property packages of differing functionality. For example, if a given property package cannot handle hypothetical components, you are not allowed access to the Oil Environment for that property package.

## Component Slates

If the Extension Property Packages has a fixed component slate, HYSYS pre-selects those components, and does not allow the user to remove them or add other components. The extension lets its container know of this restriction by setting the `NumberOfPreselectedComponents` member of the *ExtensionPPkgInit* structure to a non-zero value. HYSYS then calls the extension's *GetPreselectedCompIDs* method at a later point. If zero is passed for the `NumberOfPreselectedComponents` member, HYSYS allows you to select whatever components are available.

Filtering of the component list is done through the implementation of the *IsComponentAllowed* method. This method returns `True` if the component with the passed `ComponentID` is supported by the property package, or `False` if it is not. If the extension has a fixed component slate (that is, it

has returned a non-zero for NumberOfPreselectedComponents), the container handles the implementation of the *IsComponentAllowed* method, allowing the extension developer to return E\_NOTIMPL for the method.

If the property package cannot handle changes to the component slate, the CanExchangeComponents flag can be set in the ExtensionPPkgInit structure. If this flag has been set, HYSYS only allows you to add or remove components from the end of the list.

## ExtensionPPkgInit structure

This structure is passed to an Extension Property Packages in its *Initialize* method. The extension must fill in the structure according to its capabilities.

```
typedef struct
{
    long StructSize;
    long Version;
    long NumberOfPreselectedComponents;
    enum DynamicPropertyMethod DynPropMethod;
    VARIANT_BOOL IsActivityModelType;
    VARIANT_BOOL CanExchangeComponents;
    VARIANT_BOOL CanCalculateFugacity;
    VARIANT_BOOL CanCalculateLLE;
    VARIANT_BOOL CanHandleOilHypos;
    VARIANT_BOOL UseGFlashInDynamics;
    VARIANT_BOOL CanHandleInsideOutPHFlash;
} ExtensionPPkgInit;
```

| Data Member                   | Details  |
|-------------------------------|--|
| StructSize                    | This data member contains the size of the ExtensionPPkgInit structure.   |
| Version                       | This data member must be filled in with <b>extnCurrentVersion</b> .  |
| NumberOfPreselectedComponents | If the property package has a fixed component slate, this number should be a non-zero value.   |
| DynPropMethod                 | This must be set to the type of Dynamic Property Method to be used with the property package. See <b>DynamicPropertyMethod_enum</b> in the type library. |

| Data Member                      | Details  |
|----------------------------------|--|
| <b>IsActivityModelType</b>       | This should be set to True if the property package can be considered an activity model property package. A number of flash algorithms in HYSYS optimize their algorithms based on the value of this data member.   |
| <b>CanExchangeComponents</b>     | This member should be set to True if the property package can handle changes to the location of components in the component slate.   |
| <b>CanCalculateFugacity</b>      | This should be set to True if the property package has implemented the <i>ComputePhaseFugacities</i> method. If it is set to False, this method is never called.   |
| <b>CanCalculateLLE</b>           | This should be set to True if the property package can calculate liquid-liquid equilibrium calculations using the inside-out algorithm. If this is set to True, the property package must implement the <i>ComputeHInnerParamsLL</i> and <i>ComputeKFactorsLL</i> methods. |
| <b>CanHandleOilHypnos</b>        | If the property package can handle Oil hypotheticals, this should be set to True. If it is set to False, the user is not allowed in to the Oil Environment.  |
| <b>UseGFlashInDynamics</b>       | This flag is used to optimize thermodynamic calculations in dynamics. It is recommended that this be set to True unless the property package is an equation of state.  |
| <b>CanHandleInsideOutPHFlash</b> | This flag disables the inside-out enthalpy flash if it is set to False. It is recommended that this flag be set to True unless the property package operates on a narrow temperature range.  |

## 3.9.1 ExtnPPkgContainer Interface

The ExtnPPkgContainer interface is passed to an Extension Property Package in its *Initialize* method.

| Derived from  | Properties   | Methods   |
|---------------|--|---|
| ExtnContainer | <ul style="list-style-type: none"><li>• NumberOfComponents</li><li>• BreakRequested</li><li>• ExtensionInterface</li><li>• FPStatus</li><li>• name</li><li>• OnOleEnabledThread</li><li>• SimulationCase</li><li>• StatusBar</li></ul> | <ul style="list-style-type: none"><li>• BuildPlot</li><li>• BuildPlot2</li><li>• BuildPlotWithCallback</li><li>• ClearStatusBar</li><li>• DeletePlot</li><li>• FindVariable</li><li>• GetComponent</li><li>• GetPlot</li><li>• GetPlot2</li><li>• OpenContainerStorage</li><li>• OpenView</li><li>• Trace</li><li>• WaitForTurn</li></ul> |

## 3.9.2 ExtnPropertyPackage Interface

The ExtnPropertyPackage interface must be implemented by all Extension Property Packages. Only the *Initialize* method must be supported, all others could return E\_NOTIMPL.

| Derived from | Properties | Methods  |
|--------------|------------|--|
| IUnknown     | none       | AddComponent<br>ComponentChanged<br>ComputeHInnerParamsLL<br>ComputeHInnerParamsVL<br>ComputeKFactors<br>ComputeKFactorsLL<br>ComputeKFactorsVL<br>ComputeLiquidMolarDensity<br>ComputeLiquidSurfaceTension<br>ComputePhaseActivity<br>ComputePhaseFugacities<br>ComputePhaseProperties<br>ComputePhaseThermalConductivity<br>ComputePhaseViscosity<br>CopyPropertyPackage<br>DynTreatComponentAsInert<br>EndBasisChange<br>ExchangeComponents<br>ExchangeTwoPhases<br>GetPreSelectedCompIDs<br>GuessBubblePointTemperature<br>Initialize<br>InitializeKFactors<br>IsComponentAllowed<br>OrderPhases<br>QueryEndBasisChange<br>RemoveComponent<br>StartBasisChange |

**The ExtnPropertyPackage interface is not a dual interface, and methods of the interface will not be called through the Dispatch Invoke mechanism.**



## 3.10 Extension Unit Operations

You can implement Unit Operation calculations in HYSYS by creating an Extension Unit Operation.

To implement an Extension Unit Operation, you must implement two interfaces:

| Interface                | Description  |
|--------------------------|--|
| <b>ExtensionObject</b>   | Called when unit operation extension is added to the simulation. |
| <b>ExtnUnitOperation</b> | Called when the unit operation extension is used.                |

These objects allow the unit operation to function in the HYSYS environment. The minimum requirements for the Unit Operation Extensions is the definition of two methods:

| Method            | Description  |
|-------------------|--|
| <b>Initialize</b> | <p>The <i>Initialize</i> method is called whenever the extension is first added or whenever a case containing the extension is reopened. The Initialize method is a function that expects the current build value of HYSYS to be returned. By referencing the HYSYS Type Library it is possible to use the constant <code>extnCurrentVersion</code> to return the proper build value.</p> <p>The Initialize method passes two arguments when it is called. The first argument is the extension container object. With the extension container object, all the variables declared in the EDF can be accessed. The second argument "IsRecalling" is used to determine if the extension is being added for the first time or if the case already contained the extension. This flag can be used to set default values or to assure that the values specified by the user are not overwritten by the default values.</p> |

| Method         | Description  |
|----------------|--|
| <b>Execute</b> | <p>Extension Unit Operations perform their calculations within their <i>Execute</i> method. This method is called by the Steady State Solver during the Execute Passes; it must not be called directly by the extension.</p> <p>The Execute method is called whenever a stream connected to the extension is changed or when any of the variables marked as trigger solve in the EDF are changed. HYSYS automatically calls the Execute method and pass the Forgetting argument. The Forgetting argument relates to how HYSYS solves based on the degrees of freedom approach. Whenever a variable is changed within HYSYS, all the values associated or utilizing that value as a basis for calculation must be forgotten. This Forget process propagates throughout the simulation model. It is a good idea to check the Forgetting argument prior to executing code. Especially if values that are forgotten are used in the calculation. A forgotten value is set to the empty state, which, for HYSYS is the number -32767.</p> |

## Extension Definition Files

An extension definition file is required for the custom unit operation's visual interface within the HYSYS environment and also for the object interface to the ActiveX Server DLL. Variables that are used through the interface need to be declared in the EDF.

### 3.10.1 ExtnUnitOperationContainer Interface

The ExtnUnitOperationContainer interface is passed to an extension Unit Operation in its *Initialize* method.

| Derived from  | Properties  | Methods               |                          |
|---------------|---|-----------------------|--------------------------|
| ExtnContainer | <ul style="list-style-type: none"><li>• BreakRequested</li><li>• ExtensionInterface</li><li>• Flowsheet</li><li>• FPStatus</li><li>• name</li><li>• OnOleEnabledThread</li><li>• SimulationCase</li><li>• StatusBar</li></ul> | AddSolverNotification | FindVariable             |
|               |   | Balance               | GetPlot                  |
|               |   | BuildPlot             | GetPlot2                 |
|               |   | BuildPlot2            | OpenContainerStorage     |
|               |   | BuildPlotWithCallback | OpenView                 |
|               |   | ClearStatusBar        | RemoveSolverNotification |
|               |   | CreateFluid           | SolveComplete            |
|               |   | DeletePlot            | Trace                    |
|               |   | FindFluid             | TriggerSolve             |

## 3.10.2 ExtnUnitOperation Interface

The ExtnUnitOperation interface must be implemented by all Extension Unit Operations. Only two methods (the *Initialize* method and the *Execute* method) are mandatory.

| Derived from | Properties | Methods   |
|--------------|------------|---|
| IDispatch    | none       | <ul style="list-style-type: none"> <li>• BasisChanged</li> <li>• Execute</li> <li>• Initialize</li> </ul> |

## 3.10.3 Passes

### Execute Passes

The Solver performs steady state calculations in two passes: the *Forget Pass* and the *Calculate Pass*. Normally, extension Unit Operations need not know which pass is underway, but an **IsForgetting** parameter is passed to the extension's *Execute* method so the extension can optimize calculations if necessary.

The Solver propagates information through the flowsheet via the Solver Notification links that are set up when connections are made between objects. Whenever a Unit Operation changes the value of a variable within a linked object, that object's *Execute* method is called. If that object then changes the value of a variable in another object, the Solver then moves on to that object.

The propagation of information is completed when no object can calculate any new information, or if calculated values are within a tolerance of the value previously calculated. When new values are within the tolerance, the linked object does not have its *Execute* method called.

If two objects calculate the same value in to an object, and these values are not within the tolerance, an Inconsistency

condition occurs. When this happens, the Solver stops and switches in to Hold Mode. To allow different objects to calculate different values because of changes in the flowsheet, it is necessary that values that depend on another changing value be forgotten. This forgetting occurs during the Forget Pass.

## Forget Pass

When the value of a variable changes, the Solver first does one Solve Pass on the flowsheet with the value marked as unknown. Each object that is linked to the object with the changed variable has its *Execute* method called, and the object must perform as many calculations as it can with the remaining known information.

Any calculations that were performed based on the value of the newly forgotten variable in the last pass are not able to be calculated during this pass. After the object has finished its *Execute* call, the Solver then determines which variables the object calculated last time that have not been touched this time. These variables are then marked as unknown, and the Solver propagates this information to other linked objects in the flowsheet.

Normally, an object need not behave any differently during the Forget Pass than during the Calculate Pass. In order to prevent unnecessary propagation of forgotten information (and therefore the unnecessary recalculation of this information in the Calculate Pass), the object must still calculate all that it can to ensure that the variables it calculated last time are touched.

## Calculate Pass

After all information based on the previous value of a variable has been forgotten, the new value is set in to the variable and the second Solver pass (the Calculate Pass) is started. In this pass, each object affected by the change in the variable has its *Execute* method called. Any changes these objects make are propagated through the flowsheet as the variables in other objects are touched.

The *Execute* method of an object can be called more than once in either of the Solve Passes, as variables in the object are touched by other objects in the flowsheet.

## 3.10.4 Extension Unit Operation Example

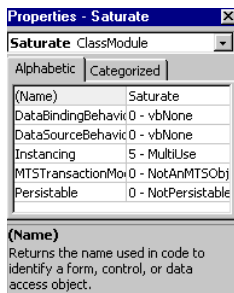
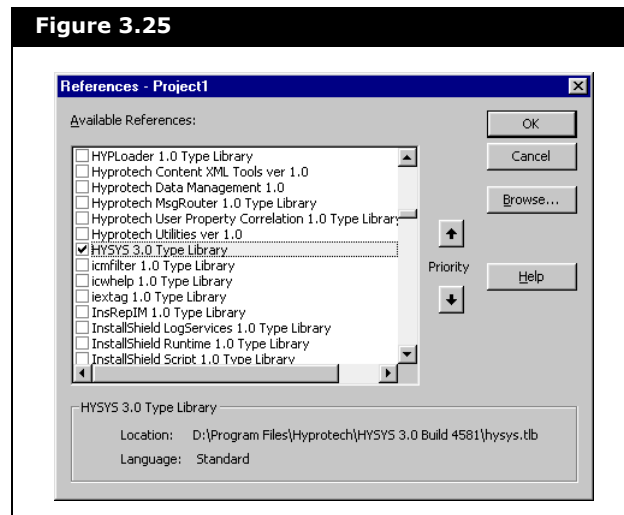
In this example, you use Visual Basic 5.0 to build a unit operation extension that saturates a feed stream with Water.



ActiveX DLL icon

1. Open a new project in Visual Basic 5.0 and from the **New** tab of the New Project property view select the **ActiveX.DLL** icon and click the **Open** button.
2. Make sure that the **HYSYS 3.\* Type Library** checkbox is selected in the References property view, which is accessed by selecting **References** command from the **Project** menu.

Figure 3.25

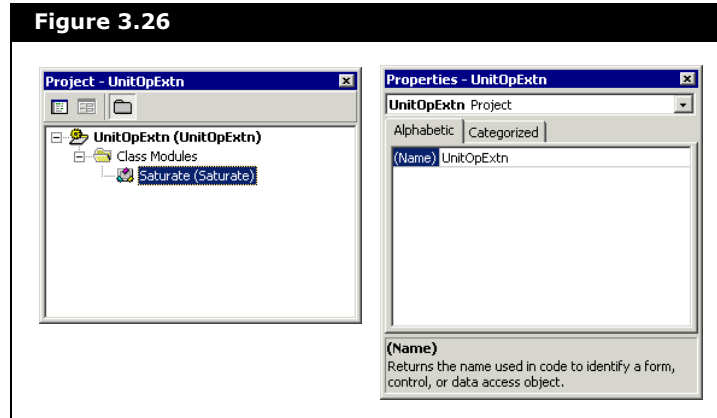


Properties tiled property view

3. In the Properties tiled property view, rename the class module **Saturate**, and ensure that the Instancing field is set to **5-MultiUse**.

4. Rename the project name to **UnitOpExtn** as shown.

Figure 3.26



5. Save the class and project by selecting **Save Project** command from the **File** menu. Save the class and project as **Saturate.cls** and **Saturate.vbp**.
6. Begin by defining the global variables in the Project Code Editor:

| Code   | Explanation   |
|--|---|
| <b>Option Explicit</b>                           | Used to force explicit declaration of all variables in that module.   |
|  | Declare the global HYSYS objects. The <b>hy</b> prefix is a convention to identify variables which come from HYSYS. |
| Dim hyContainer As<br>ExtnUnitOperationContainer | <ul style="list-style-type: none"> <li>• The extension unit operation container object.</li> </ul>                  |
| Dim hyFeedStrm As Object                         | <ul style="list-style-type: none"> <li>• The extension feed stream object.</li> </ul>                               |
| Dim hyProdStrm As Object                         | <ul style="list-style-type: none"> <li>• The extension product stream object.</li> </ul>                            |
| Dim hyWatStrm As Object                          | <ul style="list-style-type: none"> <li>• The extension water stream object.</li> </ul>                              |
|  | Declare objects used internally:  |
| Dim Components As Object                         | <ul style="list-style-type: none"> <li>• The HYSYS Components collection object.</li> </ul>                         |
| Dim Component As Object                          | <ul style="list-style-type: none"> <li>• A single HYSYS Component object.</li> </ul>                                |
| Dim WorkFluid As Object                          | <ul style="list-style-type: none"> <li>• A fluid object used for calculations.</li> </ul>                           |
| Dim WatFluid As Object                           | <ul style="list-style-type: none"> <li>• A water fluid object.</li> </ul>   |
| Dim Streams(0 To 2) As Object                    | <ul style="list-style-type: none"> <li>• An array of ProcessStream objects.</li> </ul>                              |
| Dim myOp As Object                               | <ul style="list-style-type: none"> <li>• Object reference to the Extension Interface.</li> </ul>                    |
|  | Declare variables used internally:  |
| Dim WaterPresent As Boolean                      | <ul style="list-style-type: none"> <li>• Indicates if water is present.</li> </ul>                                  |

| Code                               | Explanation   |
|------------------------------------|---|
| Dim H2O As Integer                 | • The index for water.  |
| Dim Temp As Variant                | • Temporary variable.   |
| Dim MoleFl As Variant              | • Array of molar flows.   |
| Dim Count As Integer               | • Count variable.   |
| Dim i As Integer                   | • Count variable.   |
| Dim IsKnownFeedArray As Variant    | • Are the feed streams in the array valid.                        |
| Dim CalcError(0 to 1) As Boolean   | • Error level used to display status messages.                    |
| Dim IsIgnoredBool As Boolean       | • Indicates if the unit op is ignored.                            |
| Const conEmpty As Integer = -32767 | • -32767 is used internally by HYSYS to represent an empty value. |

7. The first function declared is the **Initialize** function. It is called when the extension is first added to HYSYS or when a case containing the extension is loaded.

| Code  | Explanation  |
|---|--|
| <b>Public Function Initialize(ByVal Container As Object, ByVal IsRecalling As Boolean) As Long</b>  | Initialize is called when the extension is first added to the simulation or when a simulation case containing the extension is loaded.   |
| On Error GoTo ErrorTrap   | Enable Error trapping.   |
| CalcError(0) = False<br>CalcError(1) = False  | Initialize variables.  |
| Initialize = extnCurrentVersion   | Reference the current HYSYS version.   |
| Set hyContainer = Container<br>Set myOp = hyContainer.ExtensionInterface  | This reference lets the extension interact with HYSYS through the extension container, the <b>ExtnUnitOperationContainer</b> object. Methods from the <b>ExtensionObject</b> object are also available.                      |
| Set Components =<br>hyContainer.Flowsheet.FluidPackage.Components<br>WaterPresent = False<br>For Each Component In Components<br>If Component.Name = "H2O" Then<br>WaterPresent = True<br>Next<br>If WaterPresent Then H2O =<br>Components.Index("H2O") | Get the list of components that are currently attached to the fluid package. For each component in the list, determine if water is one of the components. If water is present, determine the internal index number of water. |

| Code  | Explanation   |
|---|---|
| <pre>Set hyFeedStrm = hyContainer.FindVariable("FeedStream").Variable.object Set hyProdStrm = hyContainer.FindVariable("ProductStream").Variable.object Set hyWatStrm = hyContainer.FindVariable("WaterStream").Variable.object</pre> | Set an object reference to the Feed, Product and Water stream attachment objects in the EDF.  |
| <pre>If IsRecalling = False Then End If</pre>   | <b>IsRecalling</b> is <b>False</b> when the extension is first added to the simulation, <b>IsRecalling</b> is <b>True</b> when a saved simulation case containing the extension is loaded. The <b>If</b> statement uses <b>IsRecalling</b> to set defaults. Saturate has no default values, so none are set here. |
| ErrorTrap:  | Line to which the <b>On Error</b> statement branches if an error occurs.  |
| <b>End Function</b>   | Signifies the end of the function. This line does not need to be added.   |

8. The other function that is required to implement a Unit Operation Extension is the **Execute** function.

| Code  | Explanation   |
|---|---|
| <b>Public Sub Execute(ByVal Forgetting As Boolean)</b>    | This sub-routine is called whenever the extension is executed.  |
| <pre>On Error GoTo ErrorTrap If Not Forgetting Then</pre> | <p>Enable Error trapping.</p> <p>When a change is made to a variable which affects the extension, HYSYS performs a <i>Forgetting</i> pass and two <i>Calculation Passes</i>. The <i>Forgetting</i> pass is used to identify the streams, unit operations, etc. affected by the change. The first <i>Calculation</i> pass is used to allow the extension to complete its internal calculations. The second <i>Calculation</i> pass is made so that external references made by the extension use correct values. If the extension makes no external references, then the second pass can be bypassed using the <i>SolveComplete</i> method of the <i>Container</i> object. This command is included later in the code. For efficiency, no calculations are made during the <i>Forgetting</i> pass.</p> |



| Code   | Explanation  |
|--|--|
| <pre> Set Components = hyContainer.Flowsheet.FluidPackage.Components     WaterPresent = False     For Each Component In Components         If Component.Name = "H2O" Then             WaterPresent = True     Next Component     If Not WaterPresent Then GoTo ErrorTrap     H2O = Components.Index("H2O")      Set hyFeedStrm = hyContainer.FindVariable("FeedStream").Variable.object     Set hyProdStrm = hyContainer.FindVariable("ProductStream").Variable.object     Set hyWatStrm = hyContainer.FindVariable("WaterStream").Variable.object      If hyFeedStrm Is Nothing Then GoTo ErrorTrap     If hyWatStrm Is Nothing Then GoTo ErrorTrap     If hyProdStrm Is Nothing Then GoTo ErrorTrap      If hyFeedStrm.TemperatureValue = conEmpty Then GoTo ErrorTrap     If hyFeedStrm.PressureValue = conEmpty Then GoTo ErrorTrap     If hyFeedStrm.MolarFlowValue = conEmpty Then GoTo ErrorTrap     Temp = hyFeedStrm.ComponentMolarFraction     If (Temp(0) = conEmpty) Then GoTo ErrorTrap     Set WorkFluid = hyFeedStrm.DuplicateFluid     MoleFl = WorkFluid.MolarFractionsValue      For i = 0 To Components.Count - 1         MoleFl(i) = MoleFl(i) / 10     Next     MoleFl(H2O) = 0.9 + MoleFl(H2O)     WorkFluid.MolarFractionsValue = MoleFl </pre> | Determine if water is present (ensure it hasn't been removed).   |
|  | Get the index for water.   |
|  | Set an object reference to the Feed, Product and Water stream attachment objects in the EDF.   |
|  | If the streams are not attached, then exit.  |
|  | Determine if the feed stream has the information required.   |
|  | Create a duplicate fluid object of <b>hyFeedStrm</b> and creates an array containing the mole fraction of each component in the fluid.   |
|  | For every component in the fluid, divide the mole fraction by a factor of 10. This means that the current composition of the stream now only make up 10% of the fluid composition. Make the remaining 90% water. |

| Code  | Explanation   |
|---|---|
| <pre> WorkFluid.TPFlash hyFeedStrm.TemperatureValue, hyFeedStrm.PressureValue   If WorkFluid.FluidPhases.Count = 1 Then     CalcError(0) = True     GoTo ErrorTrap   End If    Temp = hyWatStrm.ComponentMolarFraction   If Temp(0) = conEmpty Then     MoleFl = hyWatStrm.ComponentMolarFraction      For i = 0 To Components.Count - 1       MoleFl(i) = 0     Next i     MoleFl(H2O) = 1      hyWatStrm.ComponentMolarFraction.Erase hyWatStrm.ComponentMolarFraction.Calculate MoleFl      ElseIf Temp(H2O) = 0 Then       CalcError(1) = True       GoTo ErrorTrap     End If      With hyWatStrm       .Pressure.Erase       .Pressure.Calculate     hyFeedStrm.PressureValue       .Temperature.Erase       .Temperature.Calculate     hyFeedStrm.TemperatureValue     End With      If hyFeedStrm.MolarFlowValue = 0 Then       hyWatStrm.MolarFlow.Calculate 0       GoTo EndCalcs     End If      Set WorkFluid = hyFeedStrm.DuplicateFluid     Set WatFluid = hyWatStrm.DuplicateFluid     Count = 0      If WorkFluid.FluidPhases.Count &gt; 1 Then       hyWatStrm.MolarFlow.Calculate 0       GoTo EndCalcs     End If </pre> | <p>Do a TP Flash on the fluid at the temperature and pressure of the stream <b>hyFeedStrm</b>. If there is a second phase then an error has occurred.</p> <p>Creates a temporary array containing the component molar fraction values of the stream object <b>hyWatStrm</b> (the water stream).</p> <p>If the mole fraction of the first component in the stream is not specified, then do the following:</p> <p>Set the mole fraction of every component in the temporary array to be zero. Then set the mole fraction of water to be 1.</p> <p>Deletes the current component molar fraction values of the stream <b>hyWatStrm</b>. It then sets the component fraction of the stream to the contents of the temporary array <b>MoleFl</b>.</p> <p>Else if the mole fraction of water in the stream <b>hyWatStrm</b> is zero then an error has occurred.</p> <p>Resets the water stream temperature and pressure at the new molar composition.</p> <p>If the feed stream molar flow is 0 then exit.</p> <p>Creates a duplicate fluid of the feed and water streams and sets the counter variable <b>Count</b> to zero.</p> <p>If the number of phases in the feed stream fluid is greater than 1, then set the molar flow of the water stream to zero.</p> |

| Code  | Explanation  |
|---|--|
| <pre> Do While WorkFluid.FluidPhases.Count = 1   Count = Count + 1   Set WorkFluid = hyFeedStrm.DuplicateFluid   WatFluid.MolarFlowValue = WorkFluid.MolarFlowValue * (Count / 20)   WorkFluid.AddFluid WatFluid   WorkFluid.TPFlash hyFeedStrm.TemperatureValue, hyFeedStrm.PressureValue Loop MoleFl = WorkFluid.HeavyLiquidPhase.MolarFlowsValue  Temp = WatFluid.MolarFlowValue - MoleFl(H2O) If Temp &lt; 0 Then Temp = 0 hyWatStrm.MolarFlow.Calculate Temp  EndCalcs: WorkFluid.Erase WatFluid.Erase  With hyProdStrm   .Pressure.Erase   .Pressure.Calculate hyFeedStrm.PressureValue   .Temperature.Erase   .Temperature.Calculate hyFeedStrm.TemperatureValue End With  If hyFeedStrm.MolarFlowValue = 0 Then  hyProdStrm.ComponentMolarFraction.Calculate hyFeedStrm.ComponentMolarFractionValue   hyProdStrm.MolarFlow.Calculate hyFeedStrm.MolarFlowValue  Else   Set Streams(0) = hyFeedStrm   Set Streams(1) = hyWatStrm   Set Streams(2) = hyProdStrm   hyContainer.Balance btMoleBalance, 2, Streams End If </pre> | <p>Determine water stream flow required to saturate feed stream.</p> <p>While the number of phases in the feed stream is still one, increase the molar flow of the water stream. Add the feed and water streams and reflash the stream at the feed stream's temperature and pressure.</p>      |
|   | Set MoleFl to the values of the component molar flows of the heavy liquid phase of the fluid object WorkFluid.   |
|   | Set the variable Temp to be the difference between the flow rate of the water stream and component molar flow rate of water in the heavy liquid phase of the saturated stream. If the difference is negative (i.e., no water is required), set the molar flow rate of the water fluid to zero. |
|   | Begin the end calculations procedure.  |
|   | Erase contents of the fluid.   |
|   | Set product stream temperature and pressure values.  |
|   | If feed stream molar flow is 0 then calculate product stream as feed stream.   |
|   | If feed stream molar flow is not 0, then perform a mole balance.   |

| Code  | Explanation  |
|---|--|
| <pre> hyContainer.SolveComplete  CalcError(0) = False CalcError(1) = False End If ErrorTrap: </pre> | <p>This line prevents a second Calculation pass, because it is not required. See the comment associated with the <i>If Not Forgetting Then</i> line of code at the beginning of the code. Read the section on the <i>SolveComplete</i> method in Extending HYSYS Help file for more information.</p> |
|   | Reset error flags.   |
|   | Line to which the <i>On Error</i> statement branches if an error occurs.   |
| <b>End Sub</b>  | Signifies the end of the sub-routine. This line does not need to be added.   |

9. While the *Initialize* and *Execute* methods are required for the implementation of the unit operation extension, it is strongly recommended you also include a *Status Query* method that accurately assesses how the extension is performing.

| Code   | Explanation   |
|--|---|
| <b>Public Sub StatusQuery(hyStatus As ObjectStatus)</b>  | The StatusQuery sub-routine of the extension is used to display appropriate messages on the extension property view (EDF file) in HYSYS. This sub-routine is called whenever some change is made to the extension, whether it is a result of a solver pass or user interaction. |
| <pre> Dim OK As Boolean OK = True </pre>   | Declare and initialize the OK flag.   |
| <pre> If WaterPresent = False Then     Call hyStatus.AddStatusCondition(slMissingRequire dInformation, 1, "Water is Required as a Component")     OK = False End If </pre> | If there is no water present in the fluid package, an error message appears telling you water is required.  |
| <pre> If hyFeedStrm Is Nothing Then     Call hyStatus.AddStatusCondition(slMissingRequire dInformation, 2, "Feed Stream Required")     OK = False End If </pre>            | If there is no feed stream attached to the unit op, an error message appears telling you that a feed stream is required.  |

| Code   | Explanation   |
|--|---|
| <pre> If hyWatStrm Is Nothing Then     Call     hyStatus.AddStatusCondition(slMissingRequiredInformation, 4, "Water Stream Required")     OK = False End If </pre>   | <p>If there is no water stream attached to the unit op, an error message appears telling you that a water stream is required.</p>   |
| <pre> If hyProdStrm Is Nothing Then     Call     hyStatus.AddStatusCondition(slMissingRequiredInformation, 3, "Product Stream Required")     OK = False End If </pre>  | <p>If there is no product stream attached to the unit op, an error message appears telling you that a product stream is required.</p>   |
| <pre> If myOp.IsIgnored = True Then     Call     hyStatus.AddStatusCondition(slWarning, 11, "Ignored")     OK = False End If </pre>  | <p>If the <b>Ignored</b> checkbox is selected then send an Ignored message to the status bar.</p>   |
| <pre> If OK = False Then Exit Sub  If Not hyFeedStrm.Temperature.IsKnown Then     Call     hyStatus.AddStatusCondition(slMissingOptionalInformation, 5, "Unknown Feed Temperature")     OK = False End If </pre> | <p>These next message can wait until the connections are made so skip them.</p> <p>If the feed stream temperature is not known, then send an <i>Unknown Feed Temperature</i> message to the status bar.</p> |
| <pre> If Not hyFeedStrm.Pressure.IsKnown Then     Call     hyStatus.AddStatusCondition(slMissingOptionalInformation, 6, "Unknown Feed Pressure")     OK = False End If </pre>                                    | <p>If the feed stream pressure is not known, then send an <i>Unknown Feed Pressure</i> message to the status bar.</p>   |
| <pre> If Not hyFeedStrm.MolarFlow.IsKnown Then     Call     hyStatus.AddStatusCondition(slMissingOptionalInformation, 7, "Unknown Feed Flow")     OK = False End If </pre>                                       | <p>If the feed stream molar flow rate is not known, then send an <i>Unknown Feed Flow</i> message to the status bar.</p>  |

| Code   | Explanation   |
|--|---|
| <pre>IsKnownFeedArray = hyFeedStrm.ComponentMolarFraction.IsKnown If Not IsKnownFeedArray(0) Then     Call hyStatus.AddStatusCondition(slMissingOptiona lInformation, 8, "Unknown Feed Composition")     OK = False End If</pre> | Check to see if the feed stream's composition has been set. If it has not, an error message is sent to the status bar indicating an <i>Unknown Feed Composition</i> . |
| <pre>If CalcError(0) Then     Call hyStatus.AddStatusCondition(slError, 9, "Feed Cannot be Saturated with Water")     OK = False End If</pre>  | If the first error flag has been tripped, it sends a message to the status bar indicating that the <i>Feed Cannot be Saturated with Water</i> .                       |
| <pre>If CalcError(1) Then     Call hyStatus.AddStatusCondition(slError, 10, "Water is required in Water Stream")     OK = False End If</pre>   | If the second error flag has been tripped, it sends a message to the status bar indicating that <i>Water is Required in the Water Stream</i> .                        |
| <b>End Sub</b>   | Signifies the end of the sub-routine. This line does not need to be added.  |

10. Select **Make Saturate.dll** command from the **File** menu.

## Creating the Extension Definition File (EDF)

In order to complete the Unit Operation Extension, you must create an EDF. This is done through the HYSYS Extension View Editor.

For more information on installing and accessing the View Editor, see [Section 4.1.1 - Accessing the View Editor](#).

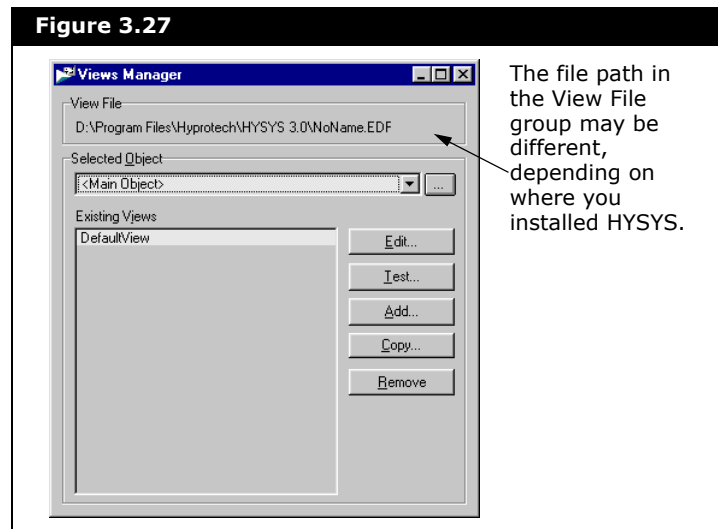
**If it has been installed, the Extension View Editor is found in the same launch point in the Start menu as HYSYS.**

1. Open the Extension View Editor. Open a new EDF by doing one of the following:
  - Select **New** command under **File** menu in the menu bar
  - Use the hot key combination **CTRL N**
  - Click the **New File** icon



New File icon

The default View Editor should appear as shown below:



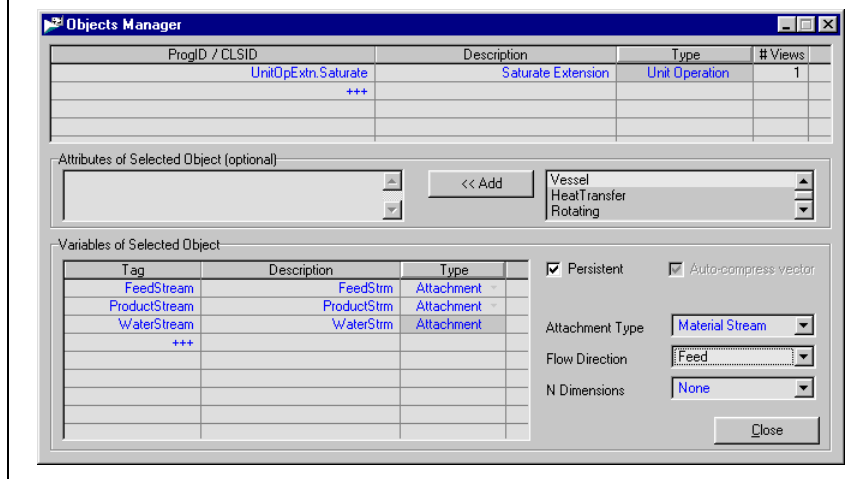
Objects Manager icon

2. Click the **Objects Manager** icon to view the Objects Manager property view.
3. In the ProgID/CLSID cell enter **UnitOpExtn.Saturate** as the extension ID.
4. Enter an appropriate description for the extension in the Description cell, such as **Saturate Extension**.
5. Select **Unit Operation** as the extension type in the Type drop-down list.
6. In the Variables of Selected Object group declare the following variables:

| Tag           | Description | Type       | Persistent | Attachment Type | Flow Direction | N Dimensions |
|---------------|-------------|------------|------------|-----------------|----------------|--------------|
| FeedStream    | FeedStrm    | Attachment | Active     | Material Stream | Feed           | None         |
| ProductStream | ProductStrm | Attachment | Active     | Material Stream | Product        | None         |
| WaterStream   | WaterStrm   | Attachment | Active     | Material Stream | Feed           | None         |

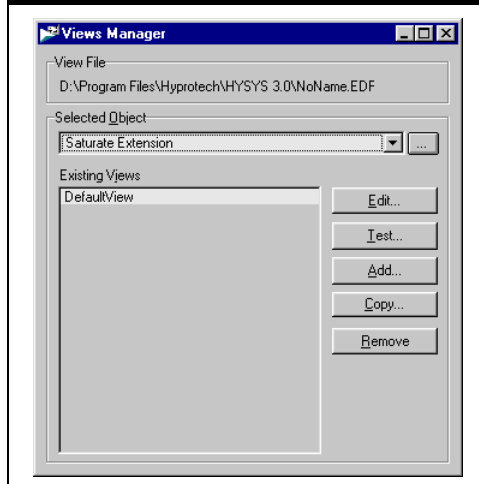
The Object Manager property view now appears similar to the figure below.

**Figure 3.28**



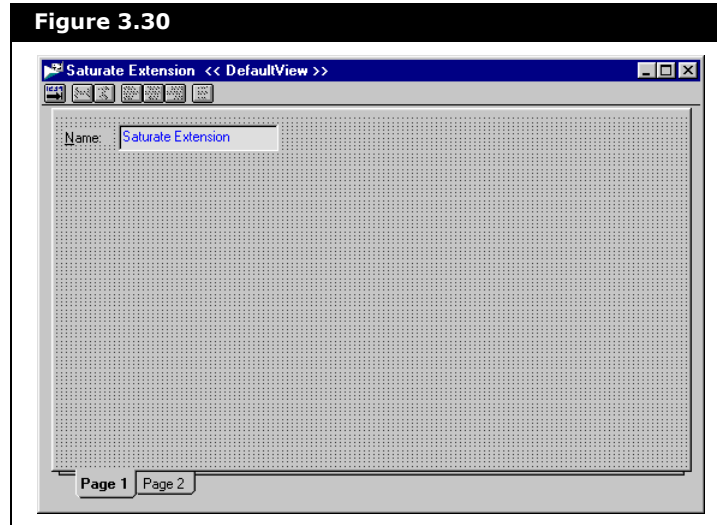
7. Click the **Close** button. This returns you to the Views Manager property view.

**Figure 3.29**






8. From the Existing Views list, select **DefaultView** and click the **Edit** button. The DefaultView form appears.

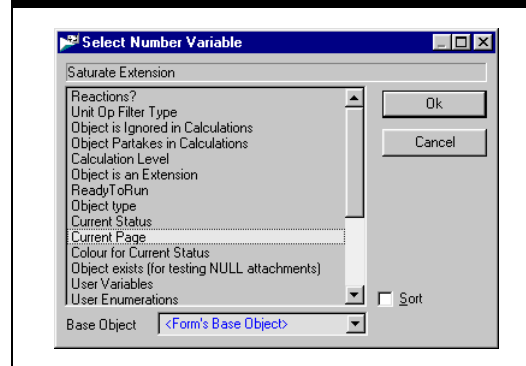
**Figure 3.30**

## Defining the Tabs

1. To open the Properties property view of the **Page Tabs** widget (or for any widget), do one of the following:
  - Double-click on the widget
  - Right-click the widget and select *<Widget Type> Properties* command from the Object Inspect menu, where *Widget Type* would be *Button* for a Button widget.
2. The Page Tabs Properties property view appears. Click the **Ellipsis** icon  associated with the Target Moniker field.

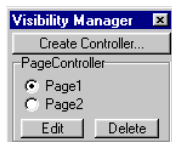
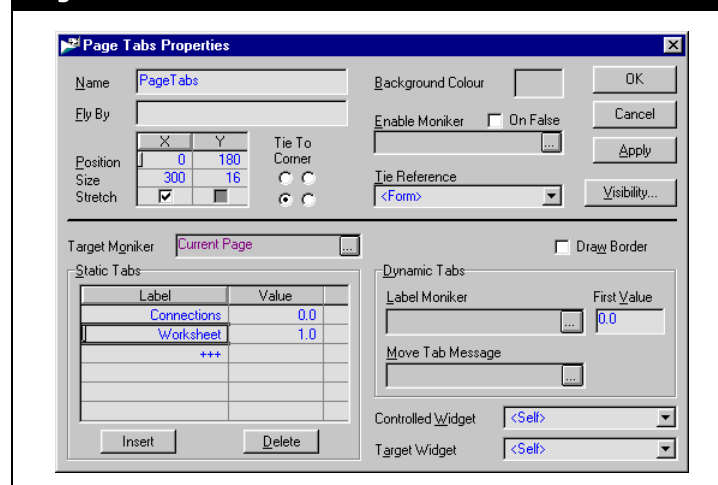
3. The Select Number Variable property view appears. From the list select **Current Page** and click the **OK** button.

Figure 3.31



4. In the Label field of the Static Tabs group change the two entries **Page1** and **Page2** to **Connections** and **Worksheet**, respectively.

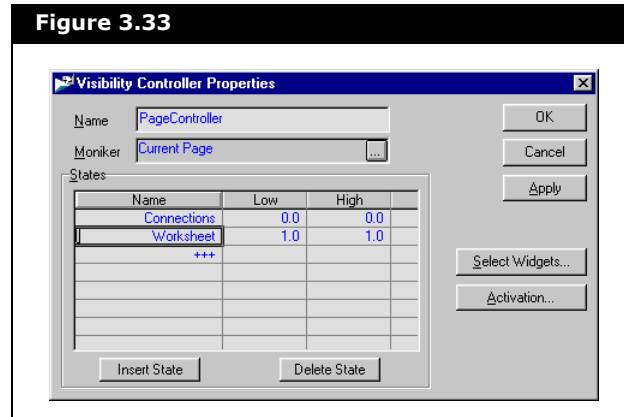
Figure 3.32



5. Close the Page Tabs Properties property view by clicking the **OK** button.
6. Now controls must be added to the tabs. Open the Visibility Manager property view by right-clicking the DefaultView form background and selecting **Open Visibility Manager** command from the Object Inspect menu.

7. A default controller has already been set up for the page tabs called **PageController**. Click the **Edit** button to view the Visibility Controller Properties property view.
8. In the States matrix, you should notice two entries: **Page1** and **Page2**. Rename these two states **Connections** and **Worksheet**, respectively, to coordinate the states to respective tab names.

Figure 3.33



9. Click the **OK** button to return to the Visibility Manager property view.  
The names of the two radio buttons that appear in the PageController group have changed to the names of the two page tabs.

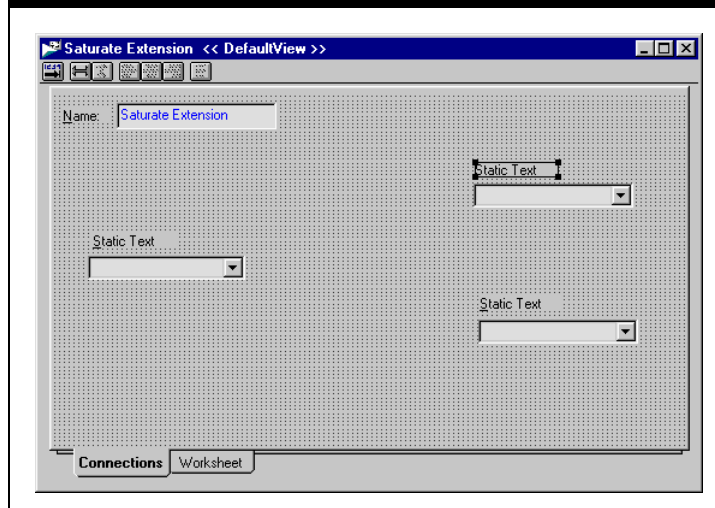
## Adding Widgets to Connections Tab

You are now ready to add widgets to the Connections tab on the DefaultView form.

1. From the Widgets Palette select the **Attachment Name** widget. Right-click, hold, and drag the widget on to the DefaultView form. Move the widget to the left side of the property view.
2. Add two more **Attachment Name** widgets to the property view using the drag and drop method described in the step above. Stagger the two widgets in the upper and lower corners of the right side as shown in **Figure 3.34**.

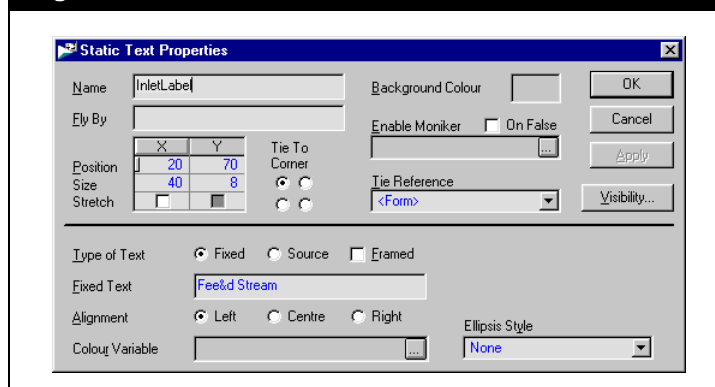
- Place a **Static Text** widget above each **Attachment Name** widget.

Figure 3.34



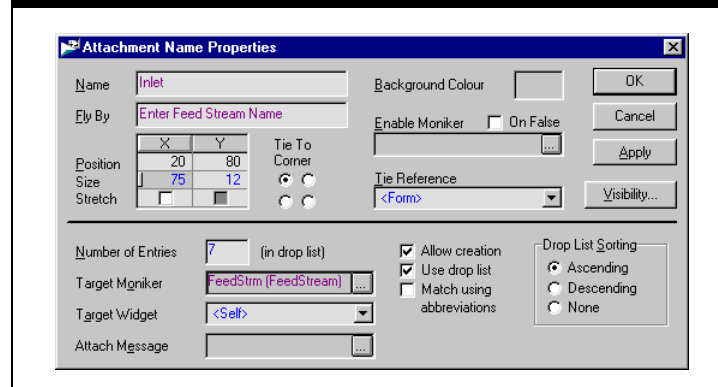
- First the Feed widgets (i.e., the Attachment Name and Static Text widget on the left) is defined. For the Feed **Static Text** widget specify properties as shown below. When you are finished click the **OK** button.


Figure 3.35



- For the Feed **Attachment Name** widget specify properties as shown below. When you are finished click the **OK** button.

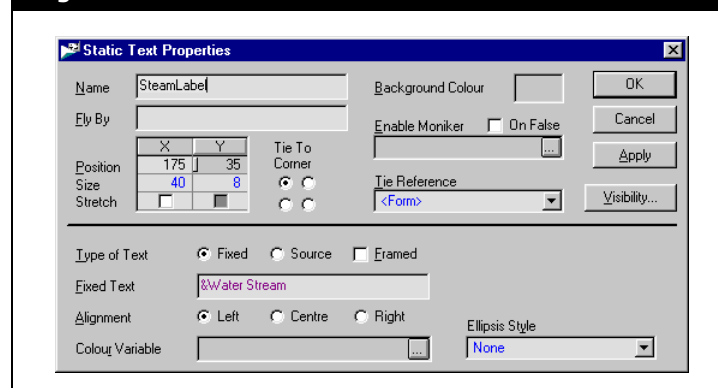
Figure 3.36



The **Target Moniker** field is specified by clicking the **Ellipsis** icon  associated with the field and selecting FeedStrm from the Select Attachment property view.

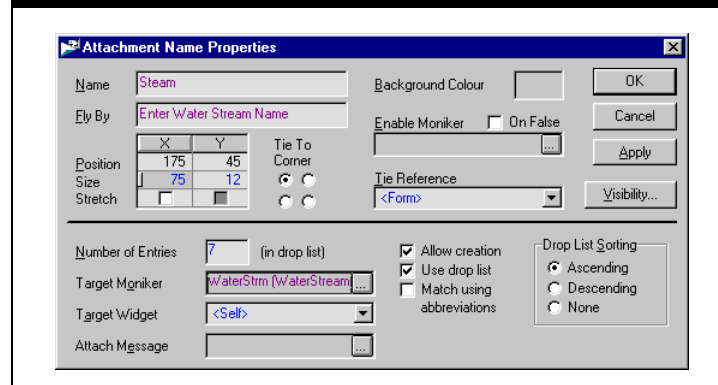
- For the Water Stream **Static Text** widget specify properties as shown below. When you are finished click the **OK** button.


Figure 3.37



- For the Water **Attachment Name** widget specify properties as shown below. When you are finished click the **OK** button.

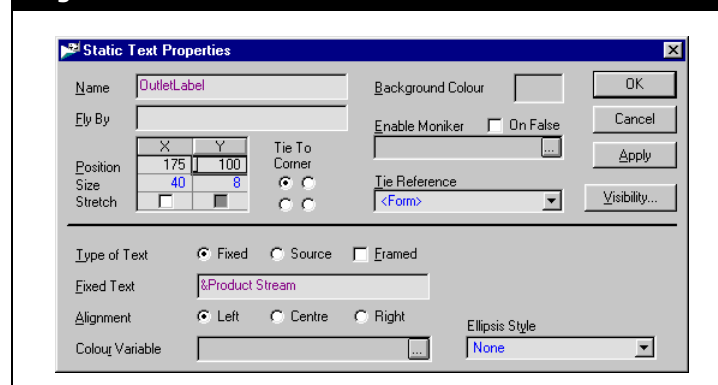
Figure 3.38



The Target Moniker field is specified by clicking the **Ellipsis** icon  associated with the field and selecting WaterStrm from the Select Attachment property view.

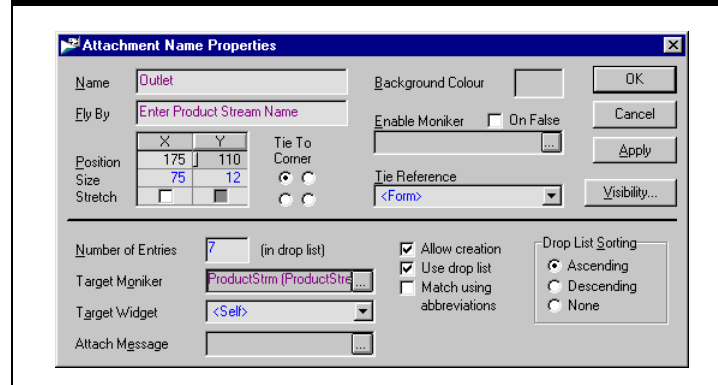
- For the Product Stream **Static Text** widget specify properties as shown below. When you are finished click the **OK** button.


Figure 3.39



9. For the Product **Attachment Name** widget specify properties as shown below. When you are finished click the **OK** button.

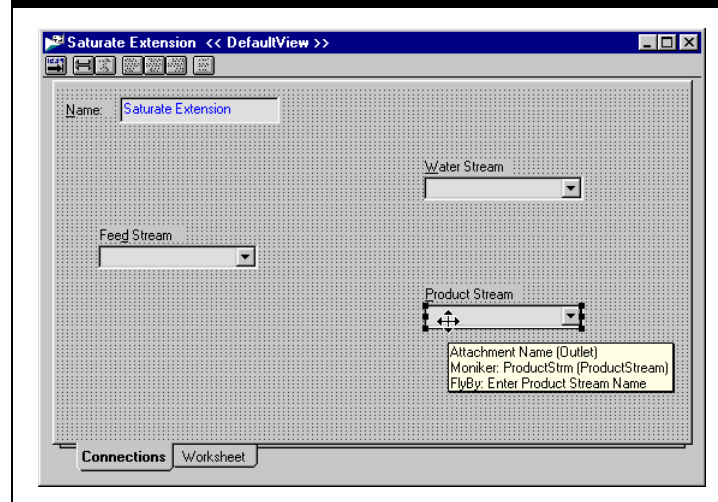
Figure 3.40



The **Target Moniker** field is specified by clicking the **Ellipsis** icon  associated with the field and selecting ProductStrm from the Select Attachment property view.

The DefaultView form now appears as shown in the figure below.

Figure 3.41

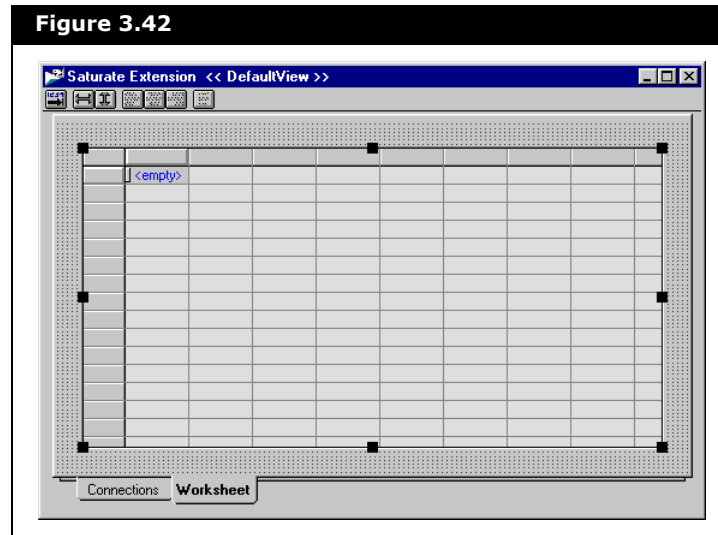


## Adding Widgets to Worksheet Tab

The next step is to add widgets to the Worksheet tab on the DefaultView form.

1. In the Visibility Manager property view, select the **Worksheet** radio button.  
To open the Visibility Manager property view, right-click the DefaultView form background and select **Open Visibility Manager** command from the Object Inspect menu.
2. Insert a **Matrix** widget on the **Worksheet** tab. Resize the widget so that about **1 cm** space appears between the matrix and tab borders.

Figure 3.42

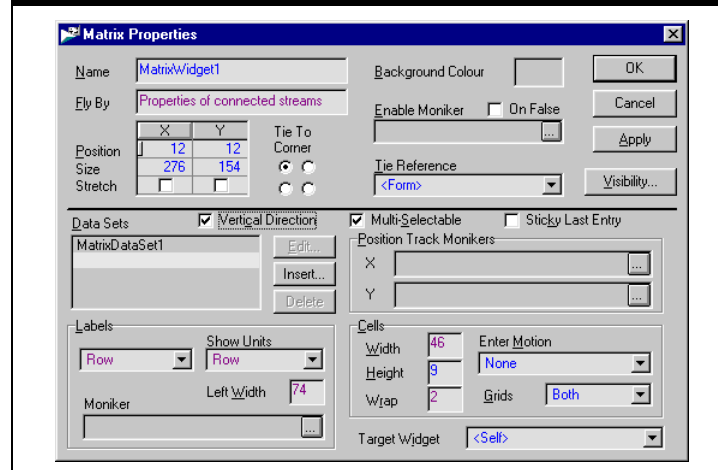


3. Open the Matrix Properties property view. In the Fly By field enter **Properties of connected streams**.
4. In the Cells group change the value in the Width field to **46** and the value in the Wrap field to **2**.
5. In the Labels group set the Labels drop-down list to **Row**, the Show Units drop-down list to **Row**, and the Left Width field to **74**.



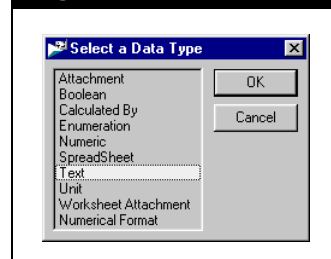
6. Select the **Vertical Direction** checkbox. The Matrix Properties property view should appear similar to the figure below.


Figure 3.43



7. The Data Set list should contain a default data set. Click the **Insert** button to open the Select a Data Type property view and add a new data set to the list.
8. On the Select a Data Type property view, select **Text** as the data type and click the **OK** button.

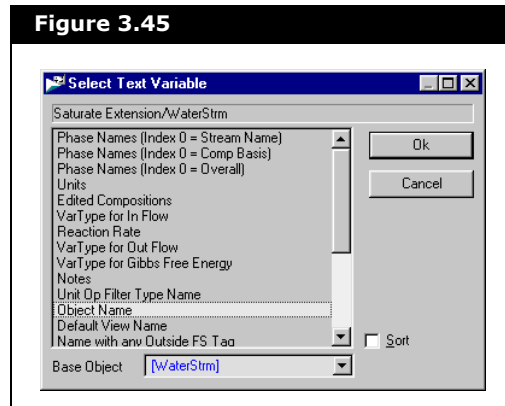
Figure 3.44



9. A Text Data Set Properties property view appears. Change the name of the data set to **WRKName**.
10. Click the **Ellipsis** icon  associated with the Moniker field to open the Select Text Variable property view.
11. On the Select Text Variable property view, select **WaterStrm** from the Base Object drop-down list.

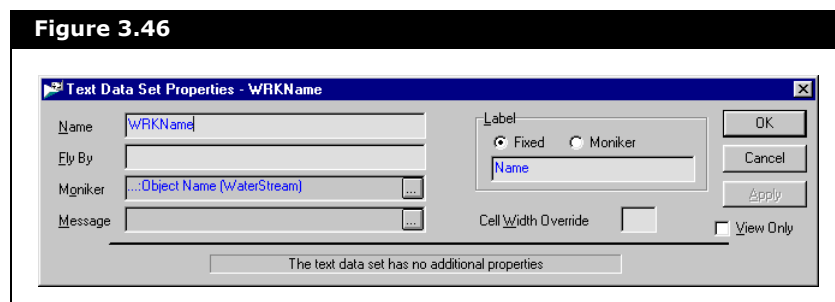
12. From the list select **Object Name** as shown in the figure below and click the **OK** button.


Figure 3.45



13. The Select Text Variable property view closes, and you are returned to the Text Data Set Properties property view.
14. In the Label group enter **Name** as the label associated with field and click the **OK** button to close the Data Set Properties property view.

Figure 3.46



15. Insert a **Numeric** data set as described in the above steps #7 and #8.
16. A Numeric Data Set Properties property view appears. Change the name of the data set to **WRKFlow**.
17. Click the **Ellipsis** icon  associated with the Moniker field to open the Select Number Variable property view.
18. On the Select Number Variable property view, select **WaterStrm** from the Base Object drop-down list.



the only two cells defined.

22. Select **Save** command from the **File** menu and save the EDF as **Saturate.edf** in the **same** directory as the DLL file.

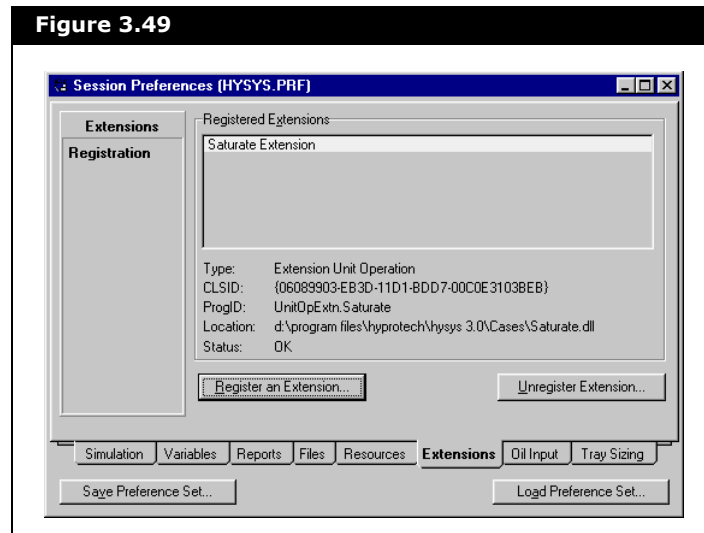
## Attaching the Extension to HYSYS

You are now ready to attach the extension to HYSYS. The following steps demonstrates how to attach an extension within HYSYS.

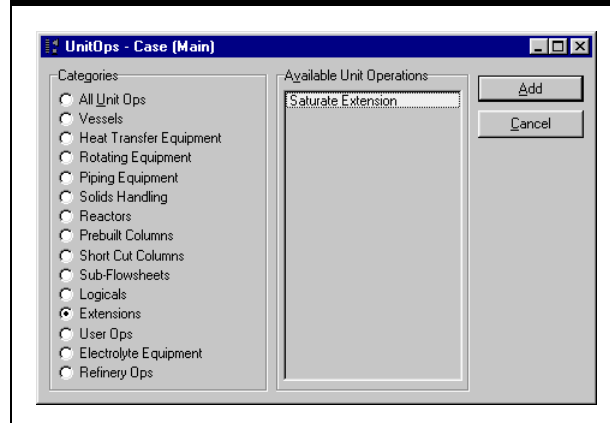
1. Start HYSYS. From the **Tools** menu, select **Preferences** command. The Session Preferences property view appears.
2. Go to the **Extensions** tab and click the **Register an Extension** button. The Select an Extension to be Registered property view appears.
3. Use the File Path group to find the directory in which the **Saturate.dll** file is saved in. Once you find the DLL, select it and click the **OK** button.

The Extensions tab now appears similar to the figure below.

**Figure 3.49**



4. You can now go in to the main Simulation environment and from the UnitOps property view find the **Saturate Extension** in the Available Unit Operations list.

**Figure 3.50**

## 3.11 References

- <sup>1</sup> "An Industrial Design/Control Study for the Vinyl Acetate Monomer Process", Luyben & Tyreus, p.4.

# 4 Extension View Editor

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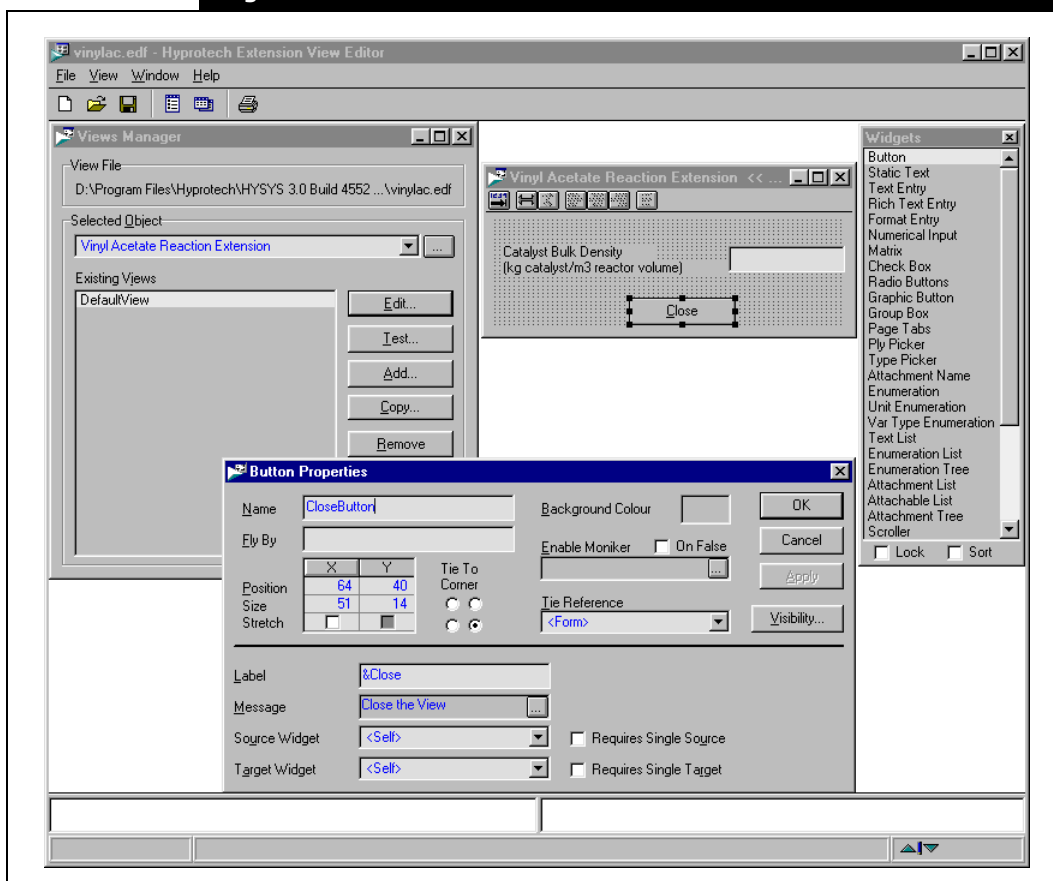
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## 4.1 Introduction

The View Editor can be used to create or modify Extension Definition Files (\*.edf). Users that are accessing the automation and extension capabilities of HYSYS generally make use of EDF files. The extension definition file acts as the interface view within HYSYS as well as the point for variable declaration and storage.

**Figure 4.1**

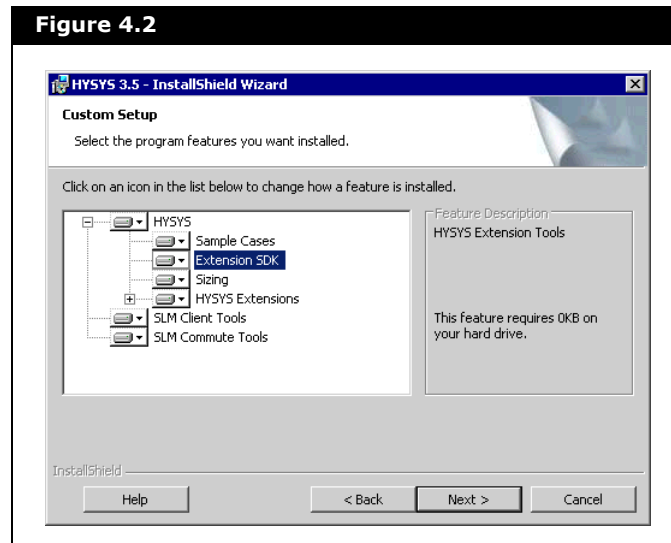




## 4.1.1 Accessing the View Editor

Access to the View Editor is provided with each commercial release of HYSYS. However, it is not available unless you have selected the **Extension SDK** option during the HYSYS installation.

**Figure 4.2**



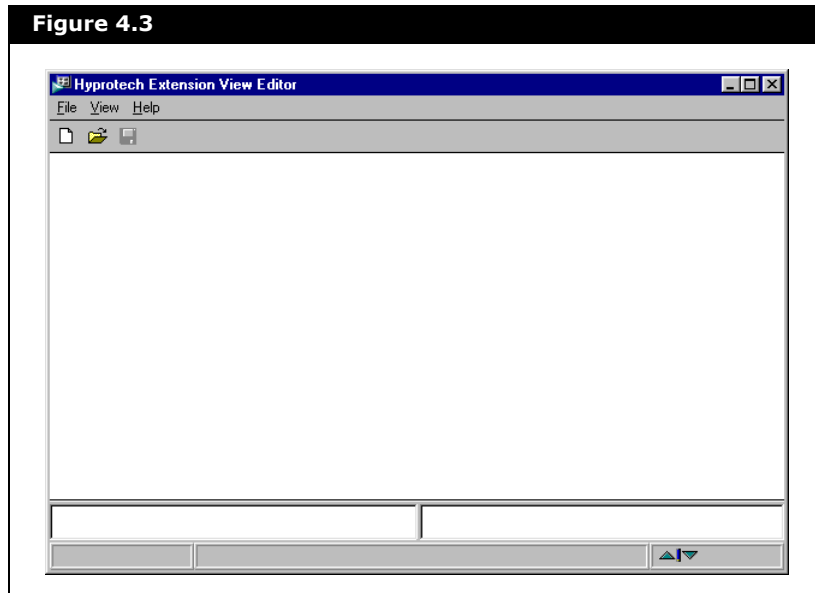
**The Extension Development SDK files option is not activated by default as it requires additional hard drive space.**

During the installation procedure, HYSYS adds the **viewed.exe** application to the directory that currently holds your HYSYS files. You can access the View Editor by either:

- Selecting the **View Editor** option in the **Start** menu where it should reside in the same launch group as HYSYS.
- Finding the directory name used to store your HYSYS files and double-clicking on **viewed.exe** in File Manager or Windows Explorer.



The View Editor appears as shown below:



You can now either open an existing EDF or create a new EDF.

## 4.1.2 Creating a New EDF File

Once the View Editor has been accessed, you can create a EDF by following this simple procedure:

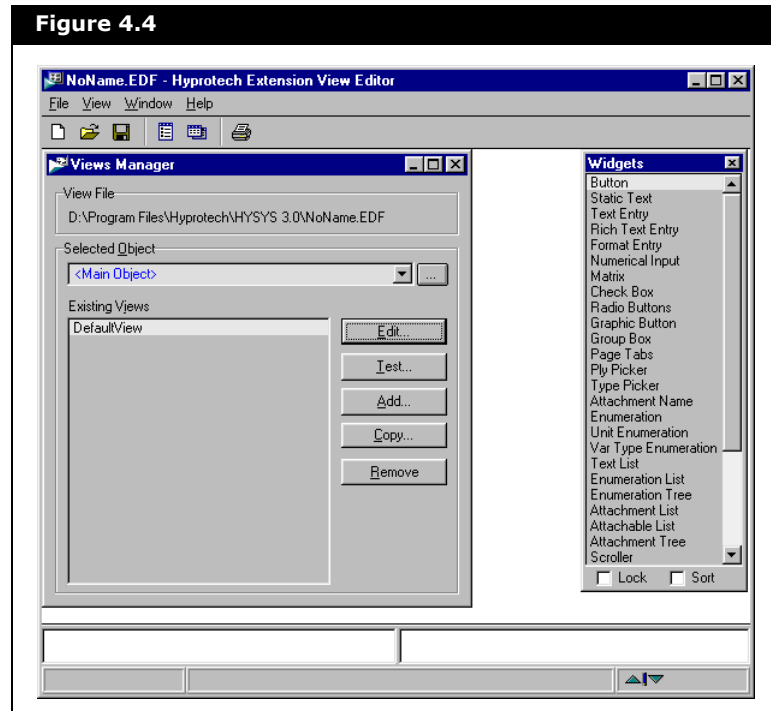
1. Do one of the following:
  - Select **New** command under **File** menu in the menu bar
  - Use the hot key combination **CTRL N**
  - Click the **New File** icon



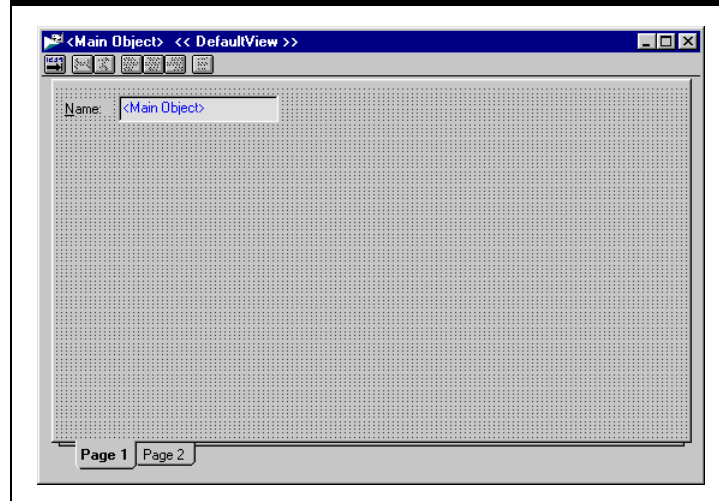
New File icon

The Views Manager property view and the Widgets Palette appears as shown in the figure below.

**Figure 4.4**



2. Assuming, at this time, that only one property view exists for this EDF file, click the **Edit** button to open the DefaultView form.

**Figure 4.5**

The DefaultView form contains three widgets: *Text Entry* widget, *Static Text* widget, and *Page Tabs* widget.

3. Delete these widgets if you do not require them. To delete a widget, simply click on the widget and do either of the following:
  - Right-click the widget and select the **Delete** command from the Object Inspect menu.
  - Press the **DELETE** key.
4. Place the widgets you want on the DefaultView form and, if needed, modify the widget properties.
5. Move and resize the widgets if required.
6. Save your work by clicking the **Save View File** icon and providing an appropriate name for the EDF file.



Save View File icon

## 4.1.3 Editing an Existing EDF File

**To edit an existing file, its 'write' attribute must be enabled (it cannot be read-only).**



Open File icon

1. To open an existing EDF file, do one of the following:
  - Select **Open** under **File** in the menu bar.
  - Use the hot key combination **CTRL O**.
  - Click the **Open View File** icon.
2. Select the EDF file from the Open View File property view and click the Open button.
3. Edit the EDF file and save the file before exiting the program.

## 4.2 Using the View Editor

### 4.2.1 Manipulating Widgets

#### Adding Widgets

You can add a widget to your property view by using the following procedure:



Drag Cursor



Bull's Eye Cursor

1. Select the widget you want to add in the Widgets Palette.
2. Right-click, hold, and drag the widget to the location on the property view where you want to place it.
3. When the widget can be properly placed on the property view, the cursor changes to a Bull's Eye. Release the mouse button and the widget appears on the property view.

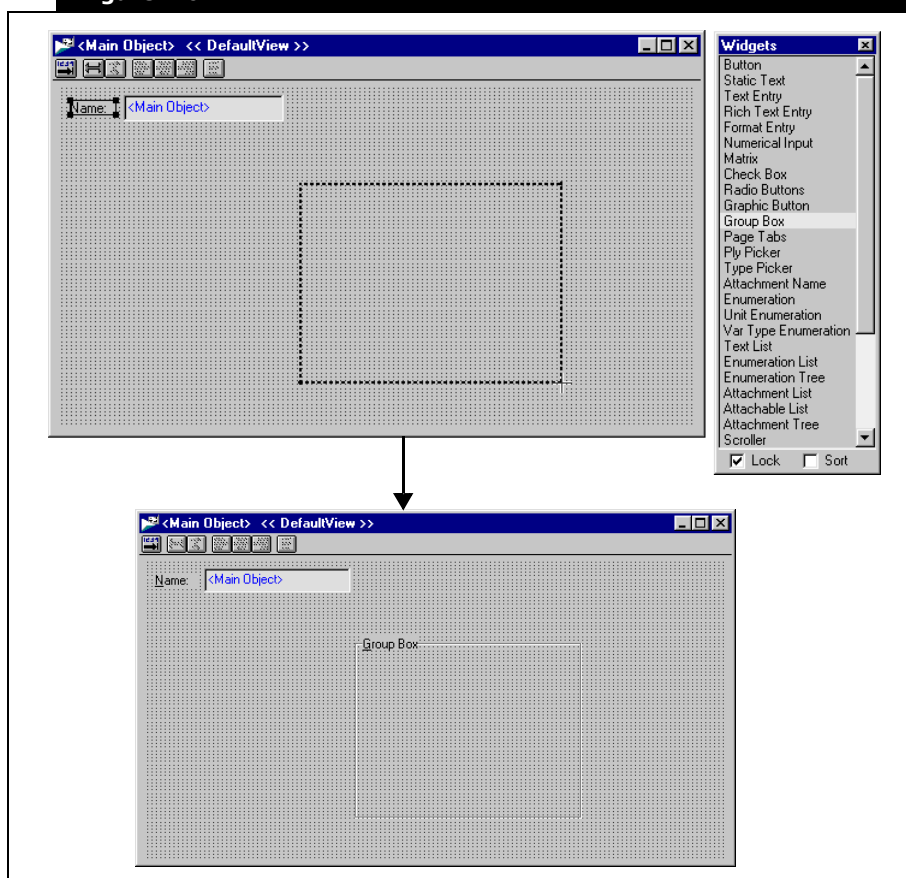
The default sized widget appears on the DefaultView form where you released the mouse button. Re-sizing handles are shown around the border of the widget, when the widget is selected.

## Alternate Approach

An alternate approach to the above steps #2 through #3 is to select the **Lock** checkbox found at the bottom of the Widgets Palette. Once the option is activated, the mouse cursor changes in to a cross-hair cursor whenever the mouse cursor is placed over the DefaultView form. You can then use the cross-hair cursor to draw the currently selected widget in the Widget Palette by clicking and dragging the cursor in the DefaultView form.

With the **Lock** checkbox selected, you can add multiple widgets of the same type simply by clicking on the DefaultView form multiple times.

**Figure 4.6**



## Deleting a Widget

To delete a widget simply select the widget and do one of the following:

- Press the **DELETE** key.
- Right-click the widget and from the resulting Object Inspect menu, select the **Delete** *<Widget Type>* command.

## Re-sizing a Widget

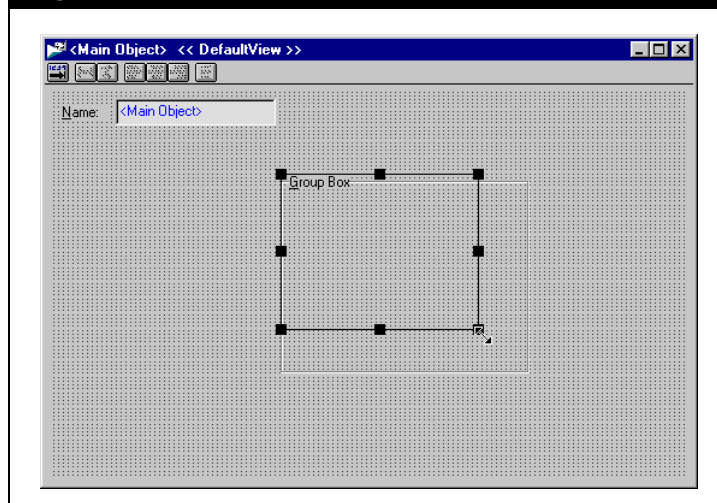
To re-size the widget using the mouse:

1. Select the widget.
2. Place the cursor over one of the re-sizing handles.

**Notice the cursor changes to a double-headed arrow.**

3. Hold down the primary mouse button and drag in one of the directions indicated by the double-headed arrow.

**Figure 4.7**



You can also select multiple widgets by dragging a frame around the widgets of choice or by selecting individual widgets while holding down the **CTRL** key. You can then simultaneously resize

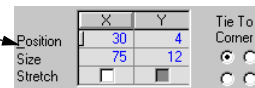
all selected widgets by resizing the anchor widget, which is the widget displayed with the resizing handles.

To re-size the widget using the Properties property view:

1. Open the widget's Properties property view.
2. On the widget's Properties property view, enter the new width and height of the widget in the XY table shown in the figure below.

**Figure 4.8**

You can also move the widget by entering new coordinate values in the Position row.



|          | X                        | Y                        |
|----------|--------------------------|--------------------------|
| Position | 30                       | 4                        |
| Size     | 75                       | 12                       |
| Stretch  | <input type="checkbox"/> | <input type="checkbox"/> |

Tie To Corner: ☐ ☐ ☐

## Moving a Widget

To move a widget:

1. Select a widget.  
You can also select multiple widgets by dragging a frame around the widgets of choice or by selecting individual widgets while holding down the **CTRL** key.
2. Hold down the primary mouse button and drag the widget to a new location.

## 4.2.2 DefaultView Form Toolbar

When you are creating a new property view or editing an existing property view, there is a toolbar containing buttons on the DefaultView form. These buttons can be used to access some of the widget properties without opening the particular widget property view.



## Active Location Settings

### Tab Order Icon

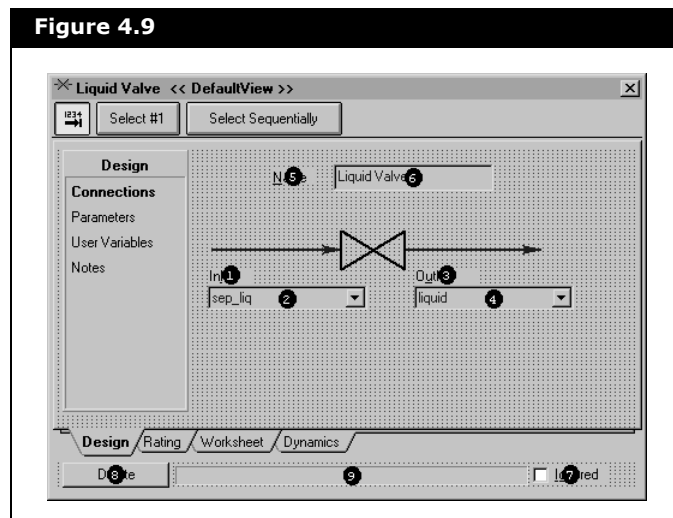


Tab Order icon

When this icon is clicked, an integer value appears over each widget on the DefaultView form that can capture the focus. The sequence of the integer values determines the order in which the widgets attain the focus when the **TAB** key is pressed.

As widgets are placed on the DefaultView form, the View Editor assigns the next available integer value to the new widget. It is possible for you to change the tab order that is assigned to the widgets.

A HYSYS valve property view is shown in the figure below and it is used to demonstrate the re-arranging of the tab order.



The tab order is indicated by the integer values in the black dots covering the widgets. From the **Name** field (#6), pressing **TAB** moves the focus to the **Ignored** checkbox (#7), then to the **Delete** button (#8) and so on.

Notice that static text widgets such as Name, Inlet and Outlet also receive tab order values. These values should always be

one below the value on the widget with which the static text is associated. This enables the associated widget to get the focus when the static text hot key is pressed. For example, when the user presses **ALT N**, the focus should be in the text entry cell where the name can be input. Since the static text Name widget (#5) cannot accept the focus, the next integer value is used (#6).

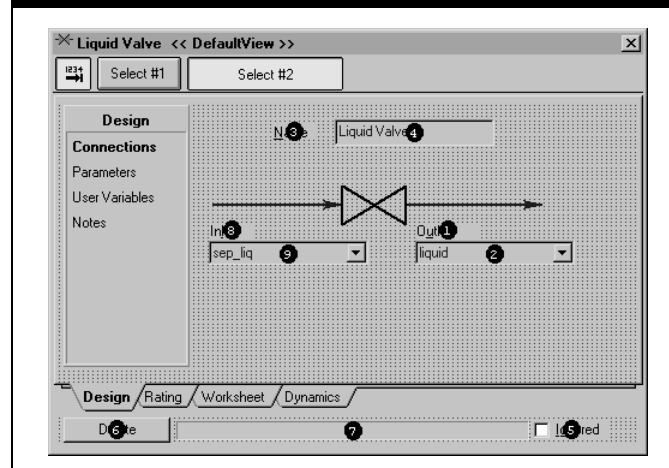
There are two approaches to changing the tab order. You can click either the *Select #1* or the *Select Sequentially* button. The following sections describe each buttons in detail.

## Select #1 Button

When you click this button, the View Editor allows you to select a different widget to carry the value #1 in the tab order. When a new #1 is selected, the tab order remains the same, but the integer values are rotated to accommodate the new #1 selection.

For example, if you clicked the Select #1 button for the valve property view shown previously, and then selected the Text Entry Outlet widget (current #3), this widget would become #1.

**Figure 4.10**



All other widgets would have their integer values increase by 1 with the old #1, the Static Text Inlet widget, becoming #8.

If this new order was not what you wanted, you could continue with a user selected order. Notice the *Select Sequentially* button has changed to a selected *Select #2* button. So you can select the widget that you would like to be #2 in the tab order. After you select a widget to be #2, the *Select #2* button changes to *Select #3* button. So you can choose the #3 widget in the tab order. The sequence number button increase with each selection until the highest number has been designated to a widget.

When the highest number (like number 9 from the figure above) has been designated, the sequence number goes back to #1 and you can resequence the property view again. You can keep resequencing the tab order until the Tab Order icon is clicked again or the property view is closed.

## Select Sequentially Button

When you click the Select Sequentially button, the View Editor allows you to select a current widget tab order value which begins the sequence of values for changes. For instance, if you clicked this button and then clicked the #4 widget, the Select Sequentially button would change in to a *Select #5* button. Once you selected the widget that you would like to be #5 in the tab order, the button would change to a *Select #6* button. This continues until the Tab Order icon is clicked again or the property view is closed.

## Sizing Icons



Stretch Width icon

- **Stretch Width**  
Clicking the **Stretch Width** icon toggles the **X-direction Stretch** checkbox (found in the widget's Properties property view) for the selected widget. When the **Stretch** checkbox is selected, the width of the widget increases as the DefaultView form is expanded horizontally. Stretching is related to the Tie To Corner and the Tie Reference properties.



Stretch Height icon

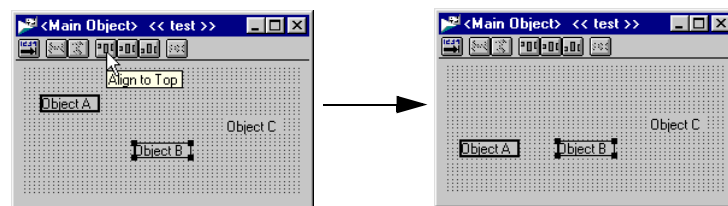
- **Stretch Height**  
Clicking the **Stretch Height** icon toggles the **Y-direction Stretch** checkbox (found in the widget's Properties property view) for the selected widget. This icon is disabled for those widgets that are not designed to stretch vertically (vertically-challenged widgets). When the **Stretch** checkbox is selected, the height of the widget increases as the DefaultView form is expanded vertically. Stretching is related to the Tie To Corner and the Tie Reference properties.

## Alignment Icons

These icons are disabled unless you select multiple widgets on a DefaultView form. The icons that become available depends on the orientation of the widgets that you have selected.

For instance, if you select two static text widgets, one being below the other, the icons that become available allow you to choose a left, centre or right alignment according to the widget that is chosen as the anchor widget.









**Figure 4.11**



In the property view shown on the left, *Object B* is the anchor widget. When the Align to Top icon is clicked, *Object A* is aligned to the top of *Object B* resulting in the property view on the right. If you wanted to align *Object B* to *A* you would select *Object A* again and *Object A* would become the anchor widget.

The anchor widget is the widget that serves as the basis for alignment and is identified by the resizing handles around its outline. The other widgets in the group selection become the widgets that are moved. To change the anchor widget, simply select another of the selected widgets. This changes the selected widget's outline from the solid black line to a thinner outline with resizing handles.

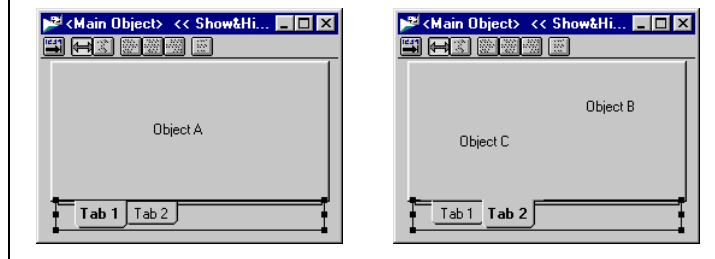
The Alignment icons that are available:

| Name                   | Description  | Icon   |
|------------------------|--|--|
| <b>Align to Left</b>   | Lines up the selected widgets according to the leftmost point of the anchor widget.  |   |
| <b>Align to Right</b>  | Lines up the selected widgets according to the rightmost point of the anchor widget.   |   |
| <b>Align to Top</b>    | Lines up the selected widgets according to the topmost point of the anchor widget.   |   |
| <b>Align to Bottom</b> | Lines up the selected widgets according to the bottommost point of the anchor widget.  |   |
| <b>Align at Centre</b> | There are two of these icons, although only one is shown at any given time. The one that appears depend on the orientation of the selected widgets. Clicking the icon lines up the selected widgets according to the centre point of the anchor widget, either in a vertical (X-axis centre point) or horizontal (Y-axis centre point) fashion, depending on the icon being shown. | <br> |
| <b>Equally Space</b>   | There are two of these icons, although only one is shown at any given time. The one that appears depend on the orientation of the selected widgets. For this icon to become available, at least three widgets must be selected. Clicking the icon vertically or horizontally spaces the widgets, depending on the icon being shown.  | <br> |

## 4.2.3 Visibility Manager

The Visibility Manager is used when you want to show or hide certain parts of your property view at specific times. In other words, it allows you to discretely select what is to be shown based on the conditions of the property view (i.e., static - done by the view designer) or the state of the application (i.e., dynamic - manipulated through code).

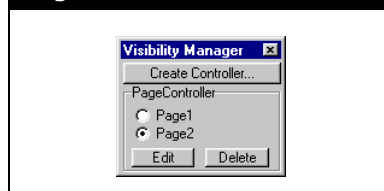
For instance, many HYSYS property views have tabs along the lower part of the property view which enable different information to be grouped and shown at different times. When the second tab on a property view is selected, the information from the first tab is typically hidden and the information specific to the second tab is shown.

**Figure 4.12**

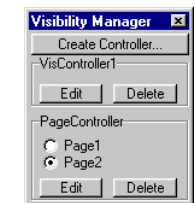
Although the Visibility Manager is used mainly with tabs, it can be used with other widgets. Other selection devices, such as radio buttons and checkboxes can prompt the use of this tool to selectively show and hide information.

The Visibility Manager can be accessed by right-clicking anywhere on the DefaultView form and selecting the Open Visibility Manager command from the Object Inspect menu.

The Visibility Manager largely consists of the Create Controller button and the controls you have created. A control is denoted by the presence of a group containing an Edit and Delete button. Each control allows you to create States, or instances when widgets or events occur. The default property view of the Visibility Manager, shown in the figure below, consists of a default PageController control which controls the visibility of the two tabs.

**Figure 4.13**

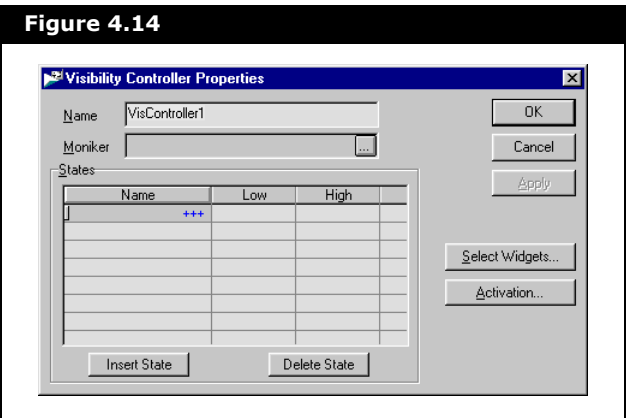
An example, if you were to select the *Page2* radio button, you would see the Page 2 tab. Only the widgets placed on this tab would automatically set to be visible on the tab in the DefaultView form.



Visibility Manager property view


Clicking the Create Controller button adds a new controller group to the Visibility Manager property view. The name of the control is the name shared by the group. You can delete a controller by clicking the Delete button associated with the controller group. You can also edit the controller by clicking the Edit button.

Clicking the Edit button opens the Visibility Controller Properties property view.



The Visibility Controller Properties property view is where individual object states are set. The property view consists of 10 objects:

Refer to **Moniker Specification** subsection from **Section 4.3 - Widget Properties** for more information.

| Object         | Description   |
|----------------|---|
| <b>Name</b>    | The controller name. The name entered in to this field is the name of that appears in the Visibility Manager.   |
| <b>Moniker</b> | Clicking the <b>Ellipsis</b> icon  associated with this field, opens the Select Number Variable property view. You can select the moniker type you want to associate to the controller using the Select Number Variable property view. |

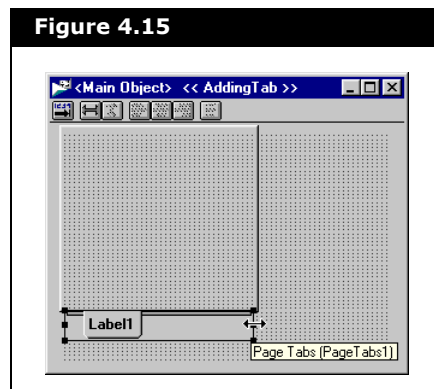
| Object                | Description   |
|-----------------------|---|
| <b>States</b>         | This group has three different fields that require specification: <ul style="list-style-type: none"> <li>• <b>Name.</b> The name of the state. This appears as a radio button in the controller group on the Visibility Manager property view.</li> <li>• <b>Low.</b> The low value for the state.</li> <li>• <b>High.</b> The high value for the state.</li> </ul> |
| <b>Insert State</b>   | Click this button to add a new state to the list.   |
| <b>Delete State</b>   | Select a state and click this button to delete the currently selected state.  |
| <b>Apply</b>          | Click this button to apply any changes made on the Properties property view to the Visibility Manager property view.  |
| <b>Select Widgets</b> | Click this button to open the Visibility Controller Widget Selections property view which allows you to associate widgets with the state.   |
| <b>Activation</b>     | Click this button to open the Visibility Controller Activation property view which allows you to create a hierarchy of visibility states.   |

## Using Tabs

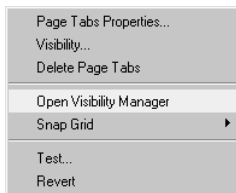
A property view created through the View Editor can contain multiple tabbed sections within the same property view. Double-clicking on the tabs of a property view opens the tab Properties property view. Labels are added for each new tab to be displayed.

1. To add a tab to a property view, right-click, hold, and drag the **Page Tab** widget from the Widget Palette into the DefaultView form.
2. Resize the tab size to your specifications.

**Figure 4.15**



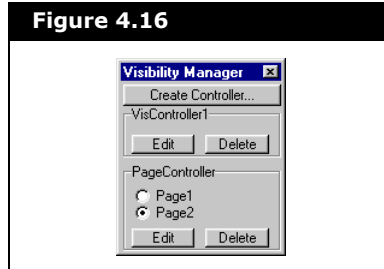




Page Tabs Object Inspect menu

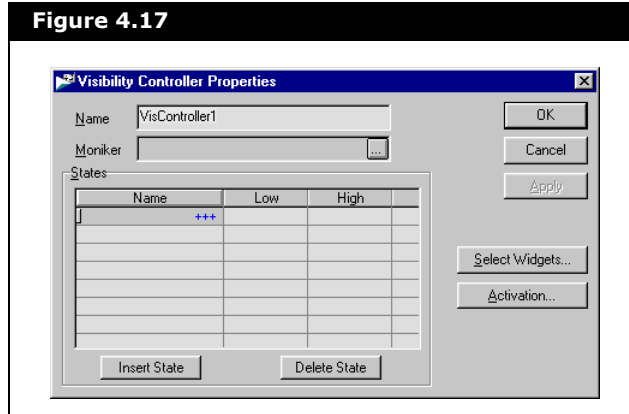
3. Right-click the DefaultView form background and select **Open Visibility Manager** command from the Object Inspect menu.
4. The Visibility Manager property view appears. Click the **Create Controller** button.
5. A **VisController** group appears above the Page Controller group as shown in the figure below.

Figure 4.16



6. Click the **Edit** button in the VisController group, to open the Visibility Controller Properties property view.

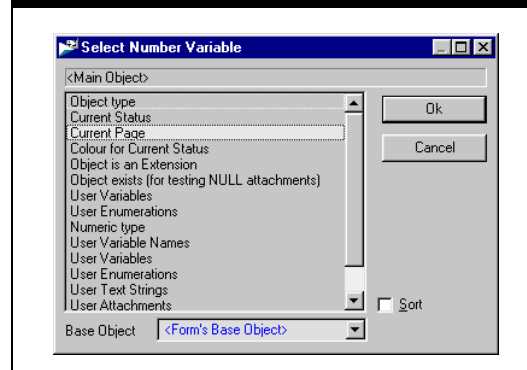
Figure 4.17



7. Click the **Ellipsis** icon  associated with Moniker field to open the Select Number Variable property view.

8. Select **Current Page** from the list in the Select Number Variable property view, and click the **OK** button.

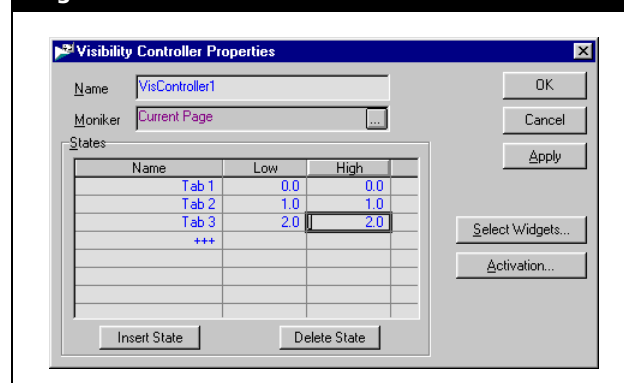
Figure 4.18



9. Enter a name for the first tab in the **Name** column of the States group.
10. Enter an integer value in the Low and High cells beside the Name cell from the above step. The integer value for both Low and High cells have to be the same.

If the values entered for the Low and High cells is not for the first tab, increment the values by one for each tabbed sheet (i.e., High and Low for first tab is 0, High and Low for second tab is 1).

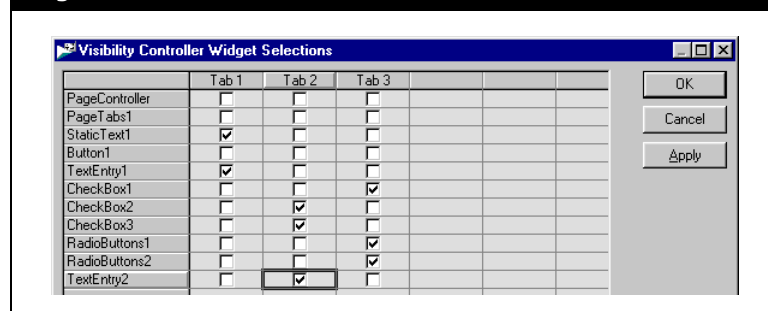
Figure 4.19



**It is required that the High/Low values provided (in #10) for each tab match the Value for each tab in the Static Tabs group of the tab Properties property view. It is highly recommended that you match the tab Name (#9) in the Visibility Controller Properties property view with the Label in the tab Properties property view.**

11. Repeat #9 and #10 for each tab.
12. Click the **Select Widgets** button. Select the checkbox under the appropriate tab name for each widget that appears only on that tab. For widgets that appears on all tabs, do not select any checkboxes.

**Figure 4.20**



## High and Low Integer Values

The values for High and Low in the Visibility Controller Properties property view do not always have to be the same. You can use the Visibility Manager to selectively show widgets according to values in the application. For example, if you want to show a static text widget when the pressure of a specific stream was between 150 and 200 kPa, you could specify the moniker representing the stream pressure in the Moniker field of the Visibility Controller Properties property view and then use the Low and High cells to specify the pressure range.

## 4.2.4 Objects Manager Property View

The Objects Manager provides a property view in which you can enter crucial information related to extensions. This information is used to register an extension properly and to declare the variables and objects used by the extension.

You can access the Objects Manager property view by either:

- Clicking the **Objects Manager** icon on the Views Manager property view.
- Selecting **Objects Manager** under **View** in the menu bar.



Objects Manager icon

Figure 4.21

The Object Manager property view consists of:

- the Object Definition matrix
- the Attributes of Selected Object group
- the Variables of Selected Object group

| ProgID / CLSID      | Description        | Type           | # Views |
|---------------------|--------------------|----------------|---------|
| UnitOpExtn Saturate | Saturate Extension | Unit Operation | 1       |
| +++                 |                    |                |         |

Attributes of Selected Object (optional)

<< Add

Vessel  
Heat Transfer  
Rotating

Variables of Selected Object

| Tag           | Description | Type       |
|---------------|-------------|------------|
| FeedStream    | FeedStrm    | Attachment |
| ProductStream | ProductStrm | Attachment |
| WaterStream   | WaterStrm   | Attachment |
| +++           |             |            |

☒ Persistent ☒ Auto-compress vector

Attachment Type: Material Stream


Flow Direction: Feed

N Dimensions: None

Close

## Object Definition Matrix

The Object Definition matrix consists of four columns:

| Column                   | Description   |
|--------------------------|---|
| <b>ProgID/<br/>CLSID</b> | The entry in this cell identifies the name of the object that owns the property views shown in the Existing Views group of the Views Manager property view.<br><br>This information must match what is in the registry and is used by HYSYS to access the proper DLL file.  |
| <b>Description</b>       | This is the text that appears in the appropriate location within HYSYS in order to select the extension.  |
| <b>Type</b>              | This specifies the type of extension. The choices include: <ul style="list-style-type: none"> <li>• Unit Operation</li> <li>• Property Package</li> <li>• Kinetic Reaction</li> <li>• Exchanger Design, Base</li> <li>• Exchanger Design, End Point</li> <li>• Exchanger Design, Simple</li> <li>• Exchanger Design, Weighted</li> <li>• DeltaP (Pressure Drop) Correlation</li> <li>• Sim Case Translator</li> <li>• ExternalAddIn</li> <li>• Pipe Deposition Correlation</li> <li>• Property Balance</li> </ul> This selection impacts the list of internal AspenTech variables that are visible when the <b>Ellipsis</b> icon  is clicked on a widget Properties property view. |
| <b>Views</b>             | The number of property views associated with this extension.  |

## Attributes of Selected Object Group

The Attributes of Selected Object group allows you to transfer the attributes of operation types to your unit operation extension. This allows you to find your extension unit operation not only under the Extension categories but also under the category of the operation whose attributes you have selected. For instance if you add the attributes of the Reactor to your extension, when you want to find your extension in the UnitOps property view, you are able find it by selecting either the Reactors or Extensions radio buttons.

## Variables of Selected Object Group

In the Variables of Selected Object group, you can specify all variable-related information for the selected object in the ProgID/CLSID cell. Once these variables are created, you can use them as monikers to associate a particular variable with a widget on your property view. Variables are defined in the table that contains three columns:

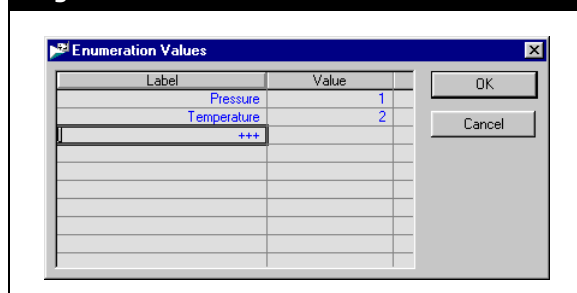
| Column      | Description   |
|-------------|---|
| <b>Tag</b>  | Represents the internal name of the variable that is stored to disk (usually input as the same as Name). You cannot have 2 identical tags for the same object.  |
| <b>Name</b> | Represents the variable name which is visible on property views in the program (usually the same as Tag). This name should be unique such that you can identify it in the program. Unlike the <b>Tag</b> , spaces are allowed in this text string.  |
| <b>Type</b> | Variable types include: <ul style="list-style-type: none"> <li>• <b>Real Number.</b> Numeric variable for which you can specify the dimensions and unit type.</li> <li>• <b>Enumeration.</b> A related set of identifiers, each of which is associated with an integer value; you can specify the dimensions and create the enumeration through the <b>Enumeration Values</b> button.</li> <li>• <b>Text.</b> A string variable for which you can specify the dimensions.</li> <li>• <b>Attachment.</b> Represents a variable associated with an object that is attached to another object (i.e., a feed stream is attached to the inlet of a pump, so the feed stream name is of type Attachment); allows you to specify the dimensions, attachment type and flow direction.</li> <li>• <b>Message.</b> A variable holding information passed when a button is clicked.</li> </ul> |

The group also consists of several additional objects that, depending on the type of the currently selected variable in the matrix:

| Object                | Description   |
|-----------------------|---|
| <b>Persistent</b>     | Select this checkbox if you want this variable value to be saved with the simulation case. Pertains to all variables except Message variables.  |
| <b>Triggers Solve</b> | Select this checkbox if you want changes in the variable to set off a smart solve (solve whatever needs to be solved). The checkbox is enabled for all variables ONLY when the object in question is a Unit Operation. For Real Number and Enumeration types, this checkbox is selected by default. |

| Object                           | Description   |
|----------------------------------|---|
| <b>Attachment Type</b>           | For Attachment variables, you can specify the attachment type as one of the following: <ul style="list-style-type: none"> <li>• <b>Stream.</b> Generic specification, implying that the stream can be either material or energy.</li> <li>• <b>Material Stream.</b> The attachment is a material stream and cannot be an energy stream.</li> <li>• <b>Energy Stream.</b> The attachment is an energy stream and cannot be a material stream.</li> </ul>   |
| <b>Flow Direction</b>            | The choice for Flow Direction impacts the PFD in its presentation of nozzles for unit operations in Attach Mode. For Attachment variables, you can specify the flow direction as one of the following: <ul style="list-style-type: none"> <li>• <b>Unknown.</b> The PFD does not know until run-time if the attachment is a feed or product; depends if the attachment is already attached to something.</li> <li>• <b>Feed.</b> Only feed nozzles are presented by the PFD.</li> <li>• <b>Product.</b> Only product nozzles are presented by the PFD.</li> </ul> |
| <b>Numeric Type</b>              | For variables of type Real Number, a unit type can be specified. This guarantees that the appropriate value appears by the property view according to the user specified unit set.  |
| <b>N Dimensions</b>              | For all variable types except Message, the variable dimensions can be specified as one of the following: <ul style="list-style-type: none"> <li>• <b>None.</b> Single value.</li> <li>• <b>Vector.</b> One dimensional array.</li> <li>• <b>Matrix.</b> Two dimensional array.</li> <li>• <b>Cube.</b> Three dimensional array.</li> </ul> Only the Real Number variable type has access to all dimension types. The other variable types have access to only None and Vector.  |
| <b>Enumeration Values Button</b> | When you click the Enumeration Values button, the Enumeration Values property view appears (as shown in <a href="#">Figure 4.22</a> ), on which you can create your enumeration. Simply enter the labels and the integer values with which the labels are associated.   |

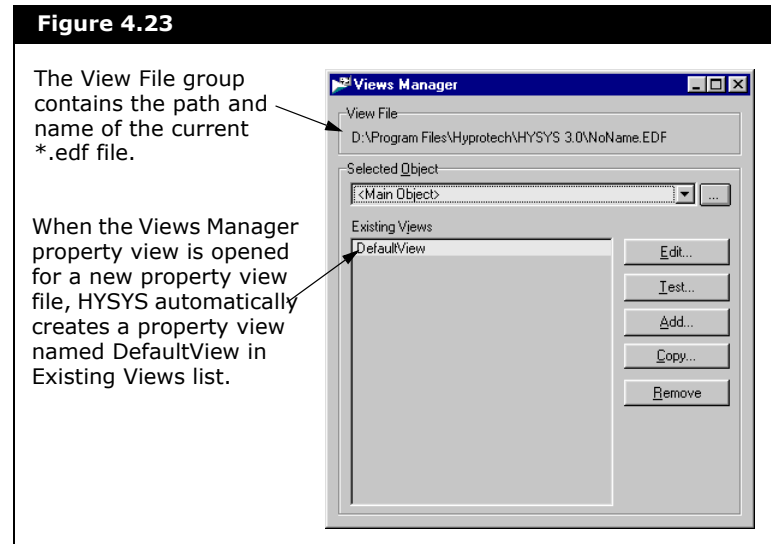
Figure 4.22



## 4.2.5 Views Manager

The Views Manager property view consists of two groups: View File and Selected Object.

**Figure 4.23**



**Each \*.edf file can have an unlimited number of objects associated with it, each of which can have an unlimited number of property views.**

### Selected Objects Group



Objects Manager icon

The Selected Object group consists of a drop-down list with an associated Objects Manager icon and the Existing Views list. The drop-down list allows you to select one of the objects defined in the Objects Manager property view. The Objects Manager icon opens the Objects Manager property view.

The Existing Views list displays all of the existing property views associated with the selected object.



From the Views Manager property view, you can click any of the buttons that pertain to the Existing Views list:

| Button        | Description  |
|---------------|--|
| <b>Edit</b>   | Opens the selected property view and the Widget Palette. |
| <b>Test</b>   | Allows you to test the property view.                    |
| <b>Add</b>    | Adds a new property view to the object.                  |
| <b>Copy</b>   | Creates a copy of the selected property view.            |
| <b>Remove</b> | Removes the selected property view from the object.      |


## 4.3 Widget Properties

As mentioned earlier in this guide, a property view is the interface seen within the HYSYS environment. Views can contain several tabs and pages of information. The controls placed on the property view are referred to within the View Editor as widgets. These include many of the typical control features associated with windows programs such as text fields/cells, checkboxes, drop-down lists, buttons, etc.

The Properties property view of a specific widget can be accessed by either:

- Double-clicking on the widget
- Right-clicking the widget and selecting *<Widget Type> Properties* command from the Object Inspect menu, where *Widget Type* would be the *Button* for a button widget.

The properties of the DefaultView form itself can also be accessed in either of the aforementioned ways.


When dealing with the properties of a widget and where applicable, you can access options for the cell/field by clicking the **Ellipsis** icon . A property view is presented from which you can make a selection that is appropriate for the widget property.




For extensions, the most important feature involves associating the widget item to a particular variable declared in the Objects Manager property view. This is accomplished through the Moniker, which is another name for a variable.

For most widgets the Target Moniker option is used to assign a specific variable to the widget.

Common widget properties are discussed in the next section, followed by widget specific properties. In the section describing the specific widget properties, an example of each widget (as well as its respective Properties property view) is shown.

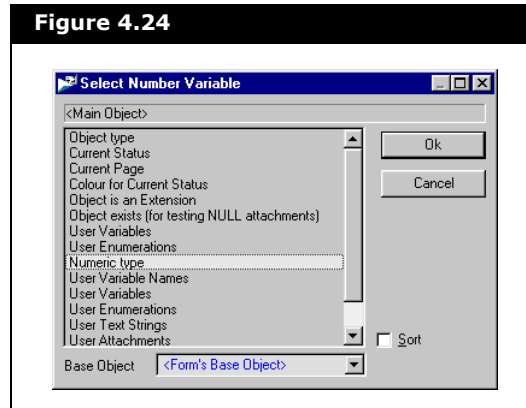
## Moniker Specification

Moniker (or variable) specification is usually done via the **Ellipsis** icon  that is usually associated with the moniker field. There are usually three types of monikers specified:

| Variable Type            | Description   |
|--------------------------|---|
| <b>Number Variables</b>  | Numerical variables are selected via the Select Number Variable property view which appears when the <b>Ellipsis</b> icon  is clicked. These variables: <ul style="list-style-type: none"> <li>• Represent numerical quantities and have a Variable Type that allows HYSYS to manage Unit Conversions for the user.</li> <li>• Can have zero, one, or two dimensions.</li> <li>• Can trigger the steady state solver when they are changed. If this is the case, the variable operates like other HYSYS variables in that the solver performs consistency checking when values are changed.</li> </ul> |
| <b>Text Variables</b>    | Text variables are selected via the Select Text Variable property view which appears when the <b>Ellipsis</b> icon  is clicked. These variables: <ul style="list-style-type: none"> <li>• Represent string quantities.</li> <li>• Can be zero- or one-dimensional.</li> </ul>  |
| <b>Message Variables</b> | Text variables are selected via the Edit Messages property view which appears when the <b>Ellipsis</b> icon  is clicked. These variables do not represent any particular quantification, but can be associated with buttons in a property view. Messages are sent through the <i>VariableChanged</i> method of an extension.   |

The Select Number Variable and Select Text Variable property view are very similar in their appearance and operation. Both consist of a list that displays the available variables in the variables set (or sub-set) selected in the Base Object drop-down list.

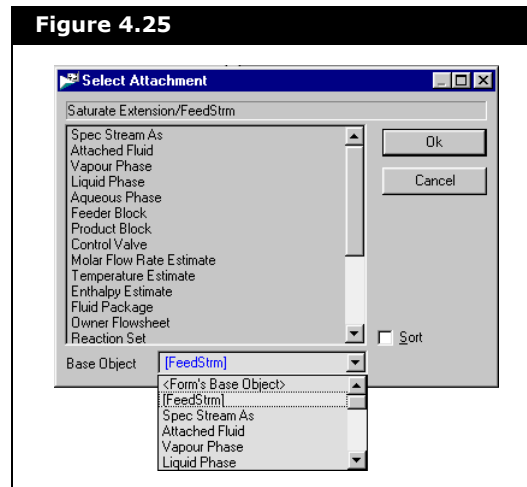
**Figure 4.24**



The Base Object drop-down list contains variable sets and sub-sets. The drop-down list acts as a path to object and object sub-sets. The default option is the <Form's Base Object>.

Notice the angle brackets around the Form's Base Object. This indicates that the options appearing below it in the drop-down list are all variable sub-sets. For example, the options that appear below the Form's Base Object option are all variable sub-sets of the DefaultView form. If such a tributary option is selected, the drop-down list hierarchy immediately changes. While the selected option appears in the field, when the drop-down list appears, the selected variable sub-set appears just below the Form's Base Object option surrounded by square brackets. Drop-down list options that appear above the current selection allow you to return to a higher level of the variable hierarchy. The options that appear below are in turn sub-sets of that selection. The display field that appears above the list displays the variable set path.

An example, suppose a stream variable was selected in the Base Object drop-down list. As shown in the figure below, FeedStrm, the material stream selected, appears in the display field.



The list above the Base Object drop-down list displays all variables that belong to this sub-set. Selecting the drop-down list shows that the list has changed. The <Form's Base Object> option is placed at the top of the list. If you wanted to return to a higher level of the object hierarchy you would select this option. Below it is the current selection in the field, FeedStrm, in square brackets. The options that appear below the Feedstrm option are all variable sub-sets of the material stream variable set.

## 4.3.1 Common Widget Properties

Each of the widgets listed in the Widgets Palette has a set of common properties listed on its respective Properties property view. Even though all widgets have access to these properties, not all of the listed properties apply to all widgets. The common properties are shown in the figure below and described in the table:

**Figure 4.26**

The screenshot shows a 'Widget Properties' dialog box for a widget named 'Button1'. The 'Name' field is 'Button1'. The 'Fly By' field is empty. The 'Position' section shows X: 97 and Y: 127. The 'Size' section shows X: 50 and Y: 14. The 'Stretch' section has two checkboxes, both unchecked. The 'Background Colour' field is empty. The 'Enable Moniker' section has a checkbox labeled 'On False' which is unchecked. The 'Tie To Corner' section has two radio buttons, both unselected. The 'Tie Reference' dropdown menu is set to '<Form>'. There are buttons for 'OK', 'Cancel', 'Apply', and 'Visibility...'.

| Object          | Description   |
|-----------------|---|
| <b>Name</b>     | Each widget is named automatically when it is placed on the DefaultView form. You can replace the default name with one that is more descriptive or meaningful.   |
| <b>Fly By</b>   | <p>Place text in this field to have a message appear in the HYSYS status bar and/or as a tool tip when the cursor is placed over the widget. The '\n' (newline sequence) is used to differentiate status bar output and tool tips. Multiple newlines allow for multi-line tool tips.</p> <p>For example, with the Fly By input of "Performs an action.\nThe sky is blue", the message to the left of the newline sequence, "Performs an action", would appear in the status bar and the message to the right of the newline sequence, "The sky is blue" would appear as a tool tip. If the newline sequence is not used, the whole message appears in the status bar.</p> |
| <b>Position</b> | The X and Y values represent the co-ordinate values of the top left corner of the widget with the reference point being the top left corner of the DefaultView form. Co-ordinate units are 1/8 of a character for the Y direction or height and 1/4 of a character for the X direction or width, where the character in question is of the size seen on a button widget.  |
| <b>Size</b>     | The X and Y values represent, respectively, the horizontal and vertical size of the widget. Co-ordinate units are 1/8 of a character for the Y direction or height and 1/4 of a character for the X direction or width, where the character in question is of the size seen on a button widget.   |

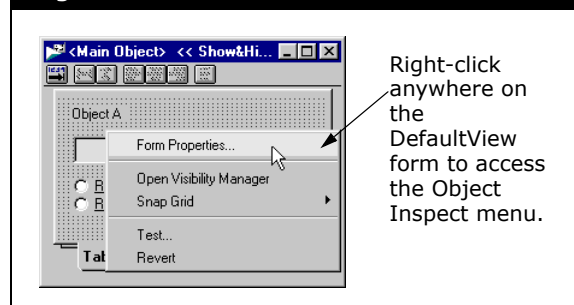
| Object                   | Description  |
|--------------------------|--|
| <b>Stretch</b>           | When the <b>X-direction Stretch</b> checkbox is selected, the width of the widget increases as the DefaultView form is expanded horizontally. When the <b>Y-direction Stretch</b> checkbox is selected, the height of the widget increases as the DefaultView form is expanded vertically.<br><br>Stretching is related to the Tie To Corner and the Tie Reference properties.   |
| <b>Background Colour</b> | Double-click the field to opens the Select A Colour property view. The Select A Colour property view allows you to select the background colour of the widget from all listed internal widget colours.   |
| <b>Enable Moniker</b>    | Allows you to provide or select a variable that allows you to control whether or not the widget is disabled/enabled (greyed out or normal) at certain times. When the variable is true, the widget is enabled.   |
| <b>On False</b>          | Select this checkbox to force a reverse effect for the Enable Moniker variable. The widget is enabled when the selected variable is false.   |
| <b>Tie To Corner</b>     | Select one of the radio buttons, which represents the corner to which the widget is bound. If the DefaultView form is stretched, you may want the widget to remain stationary relative to a certain corner of the DefaultView form. For example, a button that is placed near the lower right corner of the DefaultView form can have the lower right radio button selected. So the button is always the same distance from the lower right corner of the DefaultView form if the DefaultView form is stretched vertically or horizontally.<br><br>This property is dependent on the selection for the Tie Reference property as well as the Stretch properties. |
| <b>Tie Reference</b>     | From this drop-down list, you can choose another widget to which the currently selected widget is bound. This can be useful when you do not want to have stretching widgets overlap on a DefaultView form. Otherwise, use the default selection, which is the DefaultView form.  |
| <b>OK</b>                | Click this button to close the widget's Properties property view and accept the properties setting in the Properties property view for the widget.   |
| <b>Cancel</b>            | Click this button to close the widget's Properties property view <i>without</i> accepting any current changes made to the properties setting on the Properties property view.  |
| <b>Apply</b>             | Click this button to apply changes to the widget without closing the widget's Properties property view. This button is only available after you made at least one change to the properties setting.  |
| <b>Visibility</b>        | The Visibility button opens the Widget Visibility Control property view, which is similar to the Visibility Controller Properties property view.   |

For more information, refer to the [Section 4.2.3 - Visibility Manager](#).

## 4.3.2 DefaultView Form Object

The DefaultView form object has its own set of properties that control the appearance and functions performed by of the DefaultView form. To view and change the attributes associated with the DefaultView form you must access the Object Inspect menu of the DefaultView form.

**Figure 4.27**



## The DefaultView Form Object Inspect Menu

The DefaultView form Object Inspect menu has five commands:

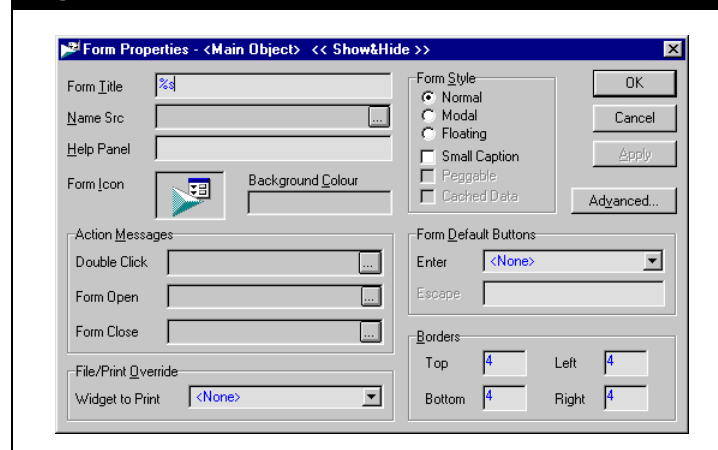
| Menu Option                    | Description   |
|--------------------------------|---|
| <b>Form Properties</b>         | Opens the Form Properties property view of the DefaultView form. For more information of this property view see <a href="#">Form Properties Property View</a> sub-section.  |
| <b>Open Visibility Manager</b> | Opens the Visibility Manager property view, from which you can create controllers.  |
| <b>Snap Grid</b>               | This option offers a sub-menu from which you can enable and disable snapping to the DefaultView form background (Snap All, Snap Selected, Disable), hide the snap grid or resize the grid (2x2, 4x2, 4x4). The default is a 2x2 grid with snapping enabled. |
| <b>Test</b>                    | Select this to view a test of your DefaultView form. Normally, this option is used to test the visibility options for widgets on the tabs and the resizing of the DefaultView form (i.e., stretching and tying of widgets).                                 |
| <b>Revert</b>                  | Selecting this option allows you to undo all changes since your last saved version for the active property view only.   |

Refer to the [Section 4.2.3 - Visibility Manager](#) for more information.

## Form Properties Property View

The DefaultView form is the only object that has a unique properties layout. It does not have the common properties listed previously.


**Figure 4.28**

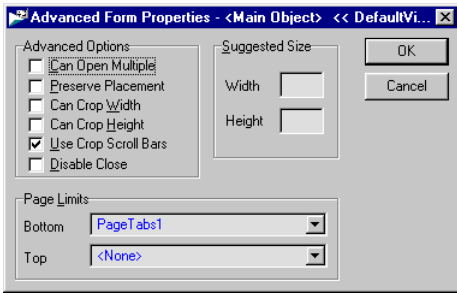



The following table contains a description of the objects in the Form Properties property view.

| Object                   | Description   |
|--------------------------|---|
| <b>Form Title</b>        | The text entered in this field, appears in the title bar of the DefaultView form. The default is a format string (%s) that simply uses the object name.   |
| <b>Name Source</b>       | Allows you to choose from a list of sources for the DefaultView form name. By default, the object name is the source.   |
| <b>Help Panel</b>        | This entry provides a link between the property view and the help system, such that a certain help topic appears when <b>F1</b> is pressed and the particular property view has focus. For extensions, this is normally left blank. |
| <b>Form Icon</b>         | The choice of icon appears in the upper left corner of the DefaultView form. Double-clicking on the icon brings up a property view from which you can choose an icon from a list of internal HYSYS icons.                           |
| <b>Background Colour</b> | Double-clicking on the associated cell brings up a property view from which you can choose a DefaultView form background colour from a list of HYSYS colours.   |



| Object                      | Description  |
|-----------------------------|--|
| <b>Form Style</b>           | <p>In this group, you can choose one of the radio buttons that assigns characteristics to the DefaultView form:</p> <ul style="list-style-type: none"> <li>• <b>Normal.</b> A DefaultView form similar to most property view in HYSYS.</li> <li>• <b>Modal.</b> A DefaultView form that always stays on top of others and does not allow access to other property views until it is closed or de-pegged; can be pegged or not, depending on the <b>Peggable</b> checkbox selection.</li> <li>• <b>Floating.</b> A DefaultView form similar to the object palette, that remains on top but does not restrict access to other property views.</li> </ul> <p>The following checkboxes are also within the Form Style group:</p> <ul style="list-style-type: none"> <li>• <b>Small Caption.</b> Selecting this checkbox reduces the height of the caption area to that of a HYSYS face plate or the object palette. The checkbox is available as a choice only to Normal style property views. The checkbox is selected by default for Floating style property views.</li> <li>• <b>Peggable.</b> Selecting this checkbox allows a modal DefaultView form to become non-modal by placing a peg in the upper right corner of the property view. The checkbox is available to Modal style property views only.</li> <li>• <b>Cached Data.</b> Selecting this checkbox allows changes to be made on the DefaultView form without the object below knowing it until the time when: <i>FlushCache</i> is called; this allows a user to make changes to the DefaultView form and then click Cancel without having the changes accepted; an example of using this is on the New Object Type form, which can be accessed from the Setup property view of the Workbook. The <b>OK</b> button sends both the <i>FlushCache</i> and <i>CloseView</i> messages. The checkbox is available to Modal style property views only.</li> </ul> |
| <b>Action Messages</b>      | <p>Allows you to specify a message to be sent, much like when a button is clicked, but in this case, when the user double-clicks the background of the DefaultView form (Double Click), opens the DefaultView form (Form Open) or closes the DefaultView form (Form Close).</p> <p>Clicking the <b>Ellipsis</b> icon  brings up a property view on which you can add, edit or delete the messages.</p>  |
| <b>Form Default Buttons</b> | <p>Select a button name from either the Enter or Escape drop-down list to have the button display its message when either the <b>ENTER</b> key or <b>ESC</b> key is pressed, respectively. Normal use is having the <b>ENTER</b> key associated with a Close button and having the <b>ESC</b> key associated with a Cancel button.</p> <p>The Enter drop-down list is available with Normal and Modal DefaultView forms, while the Escape drop-down list is only available for Modal DefaultView forms.</p>  |
| <b>File/Print Override</b>  | <p>The Widget to Print drop-down list allows the selection of a particular widget on the DefaultView form to be printed instead of the whole DefaultView form. The drop-down list changes the way Print command under the File menu works. An example of its use is on the PFD. When the PFD is printed, all you get is the PFD, not its toolbar, tabs or the DefaultView form surrounding the PFD.</p>  |

| Object          | Description  |
|-----------------|--|
| <b>Borders</b>  | <p>Allows you to specify the distance that the top, bottom, left, and right edges of the DefaultView form are from the outermost widgets. The minimum size of the DefaultView form is dictated by the placement of the widgets on the DefaultView form.</p> <p>Units of measure are 1/8 of a character for the height and 1/4 of a character for the width, where the character in question is of the size seen on a Button widget.</p>  |
| <b>Advanced</b> | <p>When you click the Advanced button, the Advanced Form Properties property view appears.</p>  <p>The following are options available in the property view:</p> <ul style="list-style-type: none"> <li>• <b>Can Open Multiple.</b> If this checkbox is cleared, the existing DefaultView form is always opened; if selected, the action of opening the DefaultView form opens a new instance each time.</li> <li>• <b>Preserve Placement.</b> If this checkbox is selected, the DefaultView form re-opens in the same location where it was before it was closed.</li> <li>• <b>Can Crop Width.</b> If this checkbox is selected, allows you to resize the property view to a width smaller than minimum required width. The minimum required width value is set to show all the widgets on the property view.</li> <li>• <b>Can Crop Height.</b> If this checkbox is selected, allows you to resize the property view to a height smaller than minimum required height. The minimum required height value is set to show all the widgets on the property view.</li> <li>• <b>Use Crop Scroll Bars.</b> This option only makes sense with one or both of the above crop setting checkboxes is selected. The cropped scroll bars appear to allow you access at the cropped area of the property view.</li> <li>• <b>Disable Close.</b> If this checkbox is selected, HYSYS greys out the <b>Close</b> icon  and the close option from the Object icon menu. HYSYS still allows CloseView messages.</li> <li>• <b>Page Limits.</b> This group contains options that allow you to specify a widget which serves as the page bottom or top reference point. These values control where the page's bevelled edges are drawn. Usually, the top is left blank and the bottom is specified as a tabs widget.</li> <li>• <b>Suggested Size.</b> This group contains fields that allow you to enter width and height values for a useful size, which can be larger than the minimum DefaultView form size; minimum DefaultView form size is, as described previously, a function of the widget placement on the DefaultView form.</li> </ul> |

## 4.3.3 Button Widget

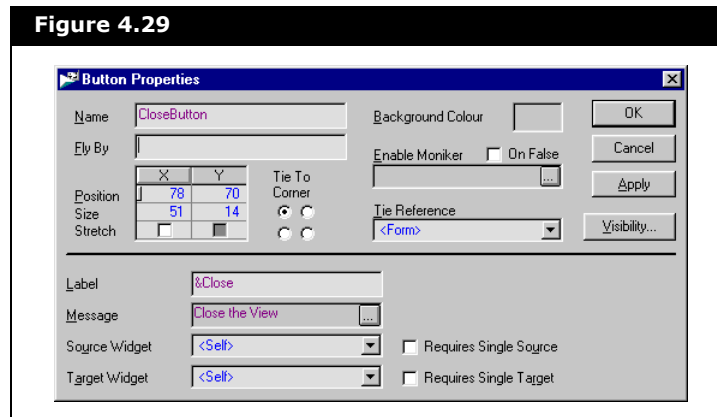
The button widget is used to send specific instructions to its base object when it is clicked by the user.

To access the Button Properties property view do one of the following:

- Double-click the button widget.
- Right-click the button widget, and select the Button Properties command from the Object Inspect menu.


The Button Properties property view appears as shown in the figure below.

**Figure 4.29**



## Button Properties

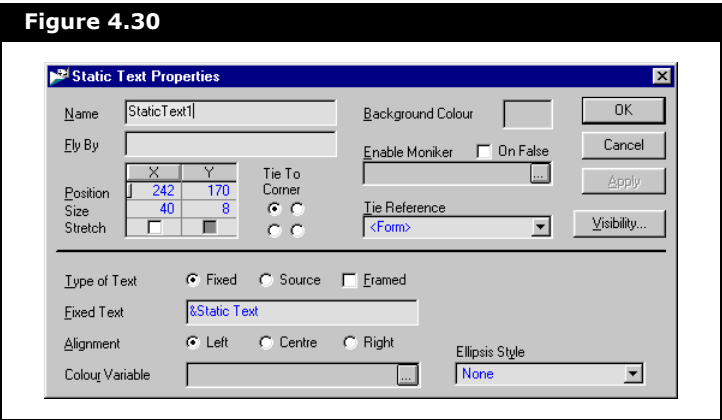
The properties available for a Button widget are described in the table below:

| Object                        | Description   |
|-------------------------------|---|
| <b>Label</b>                  | Whatever is entered in this field, is shown on the face of the button. Place an ampersand (&) before the character that gets the hot key (underscore) designation.  |
| <b>Message</b>                | <p>This is the command(s) that will be executed/fired when the button is clicked. Common examples include: Delete and CloseView.</p> <p>You can click the <b>Ellipsis</b> icon  to access the Edit Messages property view, which provides a list of the current messages that are being used for the particular button. From this property view, you can add new messages, delete existing ones, edit the list or re-arrange the order in which the messages are fired. If you have created variables of type Message in the Objects Manager, these are available for addition to the Edit Messages property view.</p> |
| <b>Source Widget</b>          | <p>Allows you to choose a widget that provides required information when the button is clicked. It is used to 'populate' the arguments for the Message.</p> <p>For example, the Simulation Basis Manager property view shows a list of fluid packages in the Current Fluid Packages group. The <b>View</b> button opens a fluid package according to the selection made in the Current Fluid Packages group. Thus the text list widget (list of fluid packages) acts as a source widget for the <b>View</b> button.</p>   |
| <b>Target Widget</b>          | <p>Allows you to choose a widget which holds a collection of objects. The selected object or multiple selected objects will be affected by the clicking of the button.</p> <p>This is illustrated by the Delete button. This button has the attachments list widget, which displays all of the column specifications, as its target widget. By clicking the Delete button, you are indirectly affecting the attachments list widget by passing the: Delete message to a particular Specification object. The target widget is not deleted, but is updated after the selected Specification object is deleted.</p>   |
| <b>Requires Single Source</b> | Selecting this checkbox limits selection in the source widget to a single item. Continuing the example cited in the Source Widget discussion, selecting this checkbox allows you to select only a single fluid package in the list.   |
| <b>Requires Single Target</b> | Selecting this checkbox limits selection in the target widget to a single item. If the button deletes items from a list, you may want to limit the user to only a single deletion per button click.   |

# 4.3.4 Static Text Widget

Use this widget to show read-only text on the application’s property view.



Figure 4.30



## Static Text Properties

The properties available for a Static Text widget are described in the table below:

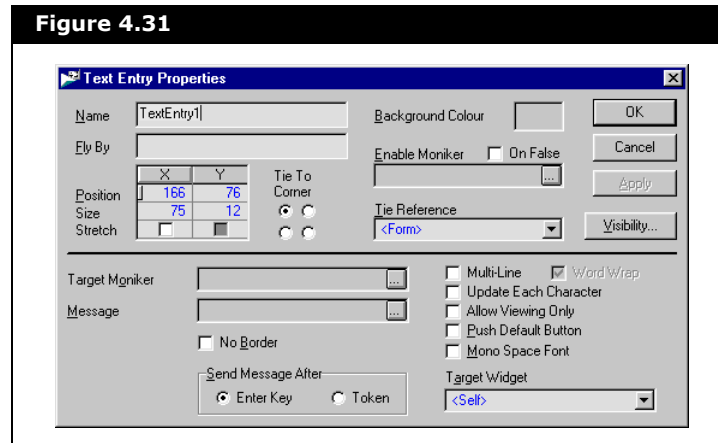
| Object       | Description   |
|--------------|---|
| Type of Text | <p>Select one of the radio buttons to specify the type of static text widget:</p> <ul style="list-style-type: none"><li>• <b>Fixed</b>. Makes the Fixed Text field available. An example of the use of this radio button is the descriptive text seen beside a numerical input field.</li><li>• <b>Source</b>. Makes the Source Moniker field and Source Widget drop-down list available. An example of the use of this radio button is the status text seen at the bottom of each unit operation property view.</li></ul> <p>There is also a <b>Framed</b> checkbox that you can select if you want the static text widget to have a frame. Unframed static text widgets can usually be seen next to numerical or text input widgets. An example of a framed version is the status text for each unit operation.</p> |
| Fixed Text   | <p>This is available only when the Fixed radio button is selected. Allows you to enter a string in the Fixed Text input field that does not change at run-time.</p>   |

| Object                 | Description   |
|------------------------|---|
| <b>Source Moniker</b>  | This is available only when the Source radio button is selected. Allows you to select a text variable that provides the string for the static text widget. Any variables of type Text that you have set up in the Objects Manager are available when you click the <b>Ellipsis</b> icon  . For a HYSYS property view status bar, the usual selection is Description of Highest Status Condition.   |
| <b>Source Widget</b>   | Available only when the Source radio button is selected. This is rarely used in HYSYS, but it allows you to choose a widget that supplies the static text with information. For example, you could select the tabs widget and have the tab label appear in the static text widget.  |
| <b>Alignment</b>       | Select a radio button to determine the justification of the text in the static text widget. Choose Left, Centre, or Right.  |
| <b>Colour Variable</b> | Allows you to select a variable that determines the background colour of the static text widget at run time. Click the <b>Ellipsis</b> icon  for current options. For a HYSYS property view status bar, the usual selection is <i>Colour for Current Status</i> .  |
| <b>Ellipsis Style</b>  | The selection in this drop-down list instructs the static text widget how to show its information when the text is too long to be fully shown. This should only apply to Source text, not Fixed text, since you know the length of fixed text and can adjust the size of the widget to accommodate it. You can choose from three available options: <ul style="list-style-type: none"> <li>• <b>None.</b> The text is cropped according to the widget size.</li> <li>• <b>Path.</b> Applies to file names; as much of the path name as possible is shown; for instance, the path <i>c:\program files\hysys\cases\ed.hsc</i> may be shown as <i>c:\...\cases\ed.hsc</i>.</li> <li>• <b>End.</b> As much as possible is shown with an ending ... if the text cannot fit.</li> </ul> |

## 4.3.5 Text Entry Widget


Use this widget to allow the user to input text on the property view.

**Figure 4.31**



## Text Entry Properties

The properties available for a Text Entry widget are described in the table below:

| Object                    | Description   |
|---------------------------|---|
| <b>Target Moniker</b>     | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br><br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Text that you have created in the Object Manager. |
| <b>Message</b>            | This is the command(s) that will be executed/fired when the <b>ENTER</b> key is pressed or the space bar is pressed, depending on the radio button selection in the Send Message After group.   |
| <b>Send Message After</b> | Select the Enter Key radio button to send the command specified in the Message input after the <b>ENTER</b> key has been pressed, or select the Token radio button to send the Message command after the space bar has been pressed.  |
| <b>Multi-Line</b>         | Select this checkbox if you would like the text entry widget to hold more than a single line of text. Scroll bars are added automatically. For more than a single line to be shown at a time, you must resize the widget accordingly.   |

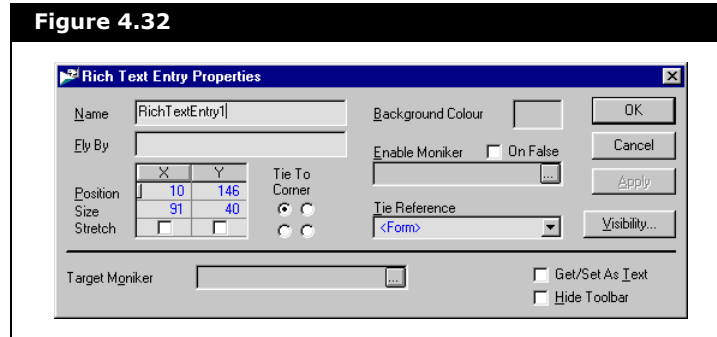
| Object                       | Description   |
|------------------------------|---|
| <b>Word Wrap</b>             | Available only when the <b>Multi-Line</b> checkbox is selected. Select this checkbox if you would like the widget to start a new line of text when the width of the widget has been reached. If this checkbox is cleared, you must use the <b>ENTER</b> key to proceed to the next line.  |
| <b>Update Each Character</b> | When this checkbox is selected, an update (Viewable methods SpecifyText and TextValue called) is performed after each character is entered. This is used in the Match cell for component selection, Components tab of the Fluid Package property view.  |
| <b>Allow Viewing Only</b>    | When this checkbox is selected, the text entry widget is read-only.   |
| <b>Push Default Button</b>   | When this checkbox is selected, pressing the <b>ENTER</b> key sends the message for the DefaultView form's default button. This is a convenience feature that allows the user to enter a text string, press <b>ENTER</b> and have the DefaultView form react as though the default button had also been pressed. It is rarely used, but can be used to have the DefaultView form accept the text input and close the DefaultView form at the same time. The default button is specified in the DefaultView form properties.   |
| <b>Mono Space Font</b>       | Select this checkbox to have characters line up perfectly in the vertical direction when using the Multi-Line functionality.<br><br>This is equivalent to selecting Mono Space as a font in the Session Preferences (Tools-Preferences).  |
| <b>Target Widget</b>         | By making a selection from this drop-down list, you are instructing the text entry widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br><br>For example, you could select an attachment list (i.e., a list of product streams) as the target widget and have the selected item in the list, an object, appear in the text entry widget. You would then have to link the Target Moniker to the object variable type associated with the attachment list. |



## 4.3.6 Rich Text Entry Widget


Use this widget to allow the user to enter text and change the text's attributes (i.e., font, colour).

**Figure 4.32**



## Rich Text Entry Properties

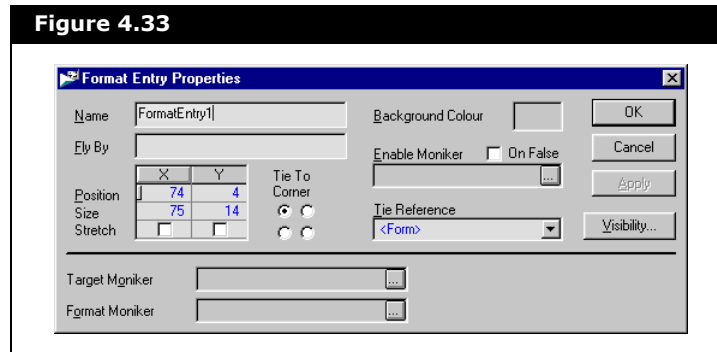
The properties available for a Rich Text Entry widget are described in the table below:

| Object                 | Description   |
|------------------------|---|
| <b>Target Moniker</b>  | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Text that you have created in the Object Manager. |
| <b>Get/Set As Text</b> | Select this checkbox if you would like all input to the widget to be treated as text. This is useful if you will be passing the moniker to a method that requires a text parameter. The entered text loses any formatting that might be attached to it (i.e., strips RTF).  |
| <b>Hide Toolbar</b>    | Selecting this checkbox hides the toolbar that accompanies the rich text entry widget.  |

## 4.3.7 Format Entry Widget


Use this widget to allow the user to choose the format for certain values on the application's property view.

**Figure 4.33**



## Format Entry Properties

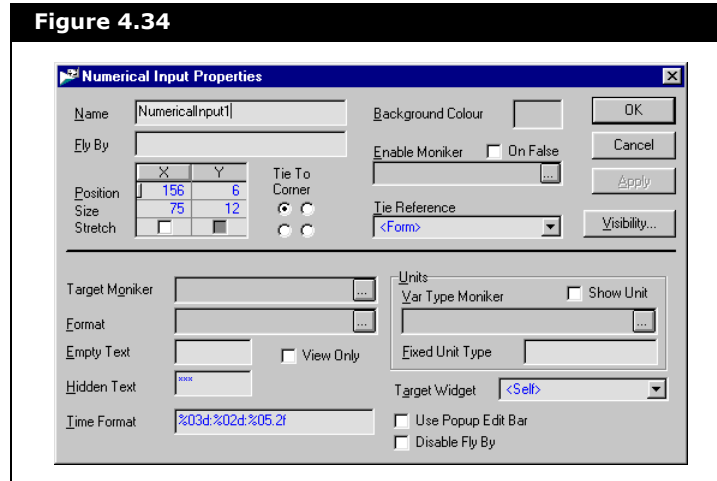
The properties available for a Format Entry widget are described in the table below:

| Object                | Description   |
|-----------------------|---|
| <b>Target Moniker</b> | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any applicable variables that you have created in the Object Manager. |
| <b>Format Moniker</b> | This is the variable that represents the default format for the widget. It is called when the user presses either the <b>DELETE</b> key in the widget or the Use Default button on the Real Format Editor property view.  |

## 4.3.8 Numerical Input Widget



Use this widget to allow the user to input numerical values on the application's property view.

**Figure 4.34**



## Numerical Input Properties

The properties available for a Numerical Input widget are described in the table below:

| Object                | Description   |
|-----------------------|---|
| <b>Target Moniker</b> | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real Number or Enumeration that you have created in the Object Manager. |
| <b>Format</b>         | Specify the format for the value in the numerical input widget.<br>Clicking the <b>Ellipsis</b> icon  brings up the Real Format Editor property view.  |
| <b>Empty Text</b>     | If the value held in the widget becomes -32767, whatever is input in the Empty Text field is shown.   |
| <b>View Only</b>      | Select this checkbox to make the widget read-only.  |
| <b>Hidden Text</b>    | If the value held in the widget becomes -32768, whatever is input in the Hidden Text field is shown.  |
| <b>Time Format</b>    | If using a target moniker with time units, specify the format to be shown.  |

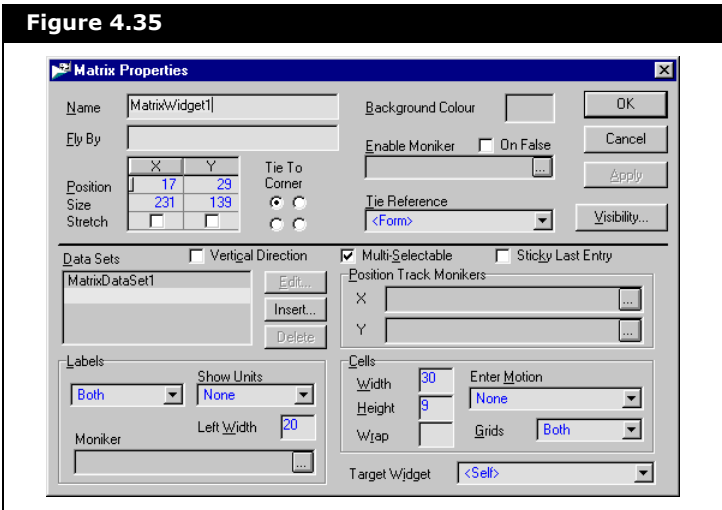
For information concerning the format of entries in this field, refer to [Section 12.3.1 - Units Page](#) from the [HYSYS User Guide](#).

| Object                    | Description   |
|---------------------------|---|
| <b>Units</b>              | <p>There are three particulars in the Units group:</p> <ul style="list-style-type: none"> <li>• <b>Var Type Moniker.</b> This is for historical purposes only and is no longer relevant (the method GetEDVarType is used internally).</li> <li>• <b>Show Unit.</b> Select this checkbox if you want to show the unit associated with the moniker with the value in the widget.</li> <li>• <b>Fixed Unit Type.</b> Enter a unit here if you want to force the value in the widget to remain as this unit type regardless of the unit set selection in the Session Preferences. For a temperature moniker, you could enter 'C' and have the value always in Celsius.</li> </ul> |
| <b>Target Widget</b>      | <p>By making a selection from this drop-down list, you are instructing the Numerical Input widget to receive its information from the <b>Target Widget</b>. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the text entry widget.</p>  |
| <b>Use Popup Edit Bar</b> | Select this checkbox if you want the edit bar to pop up beside the numerical input widget as opposed to below the property view's title bar.  |
| <b>Disable Fly By</b>     | Select this checkbox if you want to disable the fly by description that appears when the cursor is over the Numerical Input widget.   |

## 4.3.9 Matrix Widget

Use this widget to display related information in an organized fashion.

**Figure 4.35**



## Matrix Properties

The properties available for a Matrix widget are described in the table below:


| Object                         | Properties   |
|--------------------------------|--|
| <b>Data Sets</b>               | <p>In this list, you can Edit or Delete a selected data set or Insert a new data set by clicking the appropriate button. The View Editor requires a minimum of one data set at all times for the matrix widget.</p> <p>When the Insert button is clicked, you must choose the type of data set from the Select a Data Type property view. Each type has its own set of properties. Only the most frequently used data set types are described:</p> <ul style="list-style-type: none"> <li>• <b>Attachment.</b> For objects such as streams, pump curves, etc.</li> <li>• <b>Boolean.</b> Displays a checkbox (or other designated symbol) for true/false type situations.</li> <li>• <b>Enumeration.</b> Shows the enumeration label for the given enumeration value.</li> <li>• <b>Numeric.</b> For any numeric value, real or integer.</li> <li>• <b>Text.</b> For text values or labels.</li> <li>• <b>Unit.</b> Used to show and specify the unit being used (i.e. for time units, choose between seconds, minutes, hours, etc.) for other data in the matrix; provides a link for overriding the Session Preferences unit set for other matrix data.</li> </ul> |
| <b>Vertical Direction</b>      | If this checkbox is selected, data sets are added one below the next (vertical direction).   |
| <b>Multi-Selectable</b>        | If this checkbox is selected, you are able to select multiple cells in the matrix, horizontally, vertically, and diagonally.   |
| <b>Sticky Last Entry</b>       | If this checkbox is selected, placing the focus on the last entry will keep the focus on the last entry in the matrix even when additions are being made to the matrix. For instance, while the solver is performing iterations, run time data can enter a matrix. If you always wanted to see the last entry in the list, you would select the <b>Sticky Last Entry</b> checkbox and place the focus on the last entry in the matrix. Placing the focus anywhere but on the last entry will keep the focus on that particular entry, which is also the behaviour which is exhibited if the checkbox is cleared.   |
| <b>Position Track Monikers</b> | Allows you to assign different monikers to the x and y locations in the matrix so you can keep track of the exact location of the focus. An example of this functionality is in the Workbook. The Show Name Only button compresses all the stream information to show only the names of the streams. The current focus can be on any of the stream properties (i.e., name, temperature, molar flow) when uncompressed information is shown. When the Show Name Only button is clicked the focus moves to the name of the stream that held the focus, which would be a different row number.  |

| Object               | Properties   |
|----------------------|--|
| <b>Labels</b>        | <p>The Labels group has two drop-down lists, a numerical entry cell and a cell for a label moniker:</p> <ul style="list-style-type: none"> <li>• <b>Unnamed.</b> The first drop-down list is unnamed, but allows you to choose where you would like labels shown in the matrix. Your options are None, Row (place the labels in the left column on each row), Column (place the labels along the top row on each column) and Both.</li> <li>• <b>Show Units.</b> A drop-down list from which you can choose to display units along with the label on the Row, in the Column, or on Both, or choose None. This will likely coincide with your choice of whether or not to display units.</li> <li>• <b>Left Width.</b> Enter a value for the leftmost column when labels are present.</li> <li>• <b>Moniker.</b> Assign a variable for the labels. An example of its use is the assignment of labels to a matrix at run time, when you could have a variety of names in a matrix. If you are adding column specifications to the column property view, you will have no idea what specs will be added until run time, so by retrieving the spec names through a running label moniker at run time, you can perform this action.</li> </ul>  |
| <b>Cells</b>         | <p>In this group, you can set global Width, Height and Wrap values for the matrix widget. The cell width can be overridden in the individual data set properties. The cell height of 9 is the standard that is used in all HYSYS property views. The value for Wrap allows you to force a particular number of columns of data to be displayed in the matrix. After this value is reached the next column of data starts at the far left. An example of this behaviour is on the Worksheet tab of the Column unit operation (its value is set to 5).</p>   |
| <b>Enter Motion</b>  | <p>Select a direction for the focus movement when the <b>ENTER</b> key has been pressed in the matrix. The options include:</p> <ul style="list-style-type: none"> <li>• <b>None.</b> Stay in the same cell.</li> <li>• <b>Right.</b> Move to the cell to the right.</li> <li>• <b>Down.</b> Move to the cell directly below.</li> <li>• <b>Complement.</b> Move to the complementary matrix cell (i.e., if focus is in row 2, column 4 move to row 4, column 2). An example of this behaviour is in the binary coefficients matrix for the Chien Null activity model.</li> <li>• <b>Right Wrap.</b> Use this option in conjunction with the Wrap cell. When data in the last cell of the rightmost column has been input, the focus moves to the next line in the leftmost column. This is used in the property view for molecular weight/density/viscosity assay data input.</li> <li>• <b>Right if Empty.</b> If the value in the cell was &lt;Empty&gt; before input, then move to the right; if it held a value and the user is simply editing, then stay in that cell.</li> <li>• <b>Down if Empty.</b> If the value in the cell was &lt;Empty&gt; before input, then move down one cell; if it held a value and the user is simply editing, then stay in that cell.</li> <li>• <b>Complement if Empty.</b> If the value in the cell was &lt;Empty&gt; before input, then move to the complementary matrix cell; if it held a value and the user is simply editing, then stay in that cell.</li> </ul> |
| <b>Grids</b>         | <p>Specify whether you want the matrix grid shown for each Column, each Row, Both rows and columns or None at all.</p>   |
| <b>Target Widget</b> | <p>By making a selection from this drop-down list, you are instructing the matrix widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the Text Entry widget.</p>   |

## DataSet Properties

All data set types have the following common properties:

**Figure 4.36**

| Object                     | Description  |
|----------------------------|--|
| <b>Name</b>                | Retain the default name or input a more descriptive name for the data set, which appears in the Data Sets list on the Matrix Properties property view.   |
| <b>Fly By</b>              | <p>Place text in this cell to have a message appear in the HYSYS status bar and/or as a tool tip when the mouse is placed over the data set. This overrides any Fly By that has been input for the matrix widget. The '\n' (newline sequence) is used to differentiate status bar output and tool tips.</p> <p>For example, with the Fly By input of "Performs an action.\nThe sky is blue", the message to the left of the newline sequence, "Performs an action", would appear in the status bar and the message to the right of the newline sequence, "The sky is blue" would appear as a tool tip. If the newline sequence is not used, the whole message appears in the status bar.</p> |
| <b>Moniker</b>             | <p>This is the variable to which you put your data and/or from which you get your data. It is the variable that is associated with the data set.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any appropriate variables that you have created in the Object Manager.</p>  |
| <b>Message</b>             | This is the command(s) that will be executed/fired when the <b>ENTER</b> key is pressed.   |
| <b>Label</b>               | Select either the Fixed or Moniker radio button and then either specify a static label or associate a moniker with the data set label.   |
| <b>Cell Width Override</b> | Enter a width for the data set cell that overrides the value in the Width cell of the Cells group on the Matrix Properties property view.  |
| <b>View Only</b>           | Select this checkbox to make the data set read-only.   |

Specific data set type properties include:

## Attachment

**Figure 4.37**



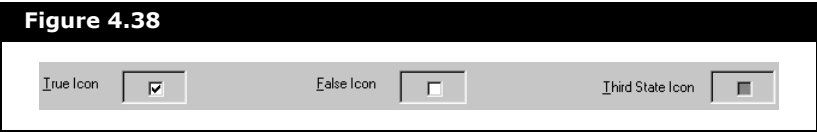
Drop List Sorting: Ascending ☒ Allow Creation

Expand Style: Never ☒ Show Tag Names

| Object                   | Description  |
|--------------------------|--|
| <b>Drop List Sorting</b> | Assign a type of sorting for the list of attachments that appears in the drop-down list: Ascending (alphabetical), Descending (reverse alphabetical) or None.  |
| <b>Expand Style</b>      | <p>This is the recommended way, by controlling through the widget instead of through code, to control how the matrix expands.</p> <p>There are three selections in this drop-down list:</p> <ul style="list-style-type: none"> <li>• <b>Always.</b> Adds another field to the matrix when the current boundary is exceeded. The default setting for Empty Text is &lt;Empty&gt;. An example of this behaviour is found for unit operations that can handle multiple feeds or products. You are first presented with something like &lt;New Feed&gt;. As you add feeds, the matrix is expanded and &lt;New Feed&gt; is added to the bottom of the list. When the physical size of the matrix is exceeded, scroll bars appear and another field is added to the bottom of the list. In this case, the.edf file has been modified through a text editor to change the Empty Text from &lt;Empty&gt; to &lt;New Feed&gt;.</li> <li>• <b>Never.</b> The matrix is limited to the physical size of the widget.</li> <li>• <b>Limit.</b> Supply a limit for the maximum size that is allowed for the data set.</li> </ul> |
| <b>Allow Creation</b>    | Select this checkbox if you want the user to be able to type in a name and have a new object (of the particular type) be created and added to the list if the name does not already exist.   |
| <b>Show Tag Names</b>    | If this checkbox is selected, you will see the flowsheet name attached to the object name if you are currently not in the flowsheet where the object resides (i.e., from the column environment, you might see Feed@Main if the stream Feed was created in the main environment).  |



Boolean



| Object           | Description   |
|------------------|---|
| True Icon        | Double-click on this cell to select an icon that represents the true value of the Boolean, which is the value 1.  |
| False Icon       | Double-click on this cell to select an icon that represents the false value of the Boolean, which is the value 0.                                       |
| Third State Icon | Double-click on this cell to select an icon that represents the (often misunderstood) other state of the Boolean, which is any value other than 0 or 1. |


Enumeration



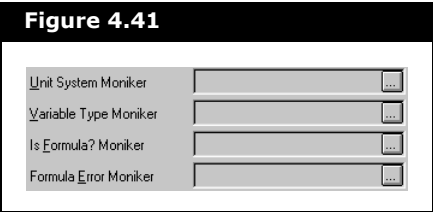
| Object                  | Description   |
|-------------------------|---|
| Specify EMPTY on Delete | Select this checkbox if you want -32767 to be set in the variable when the user presses <b>DELETE</b> . |

## Numeric

**Figure 4.40**

| Object                                | Description  |
|---------------------------------------|--|
| <b>Format</b>                         | Specify the format for the value in the data set. Clicking the <b>Ellipsis</b> icon  brings up the Real Format Editor property view.  |
| <b>Empty Text</b>                     | If the value held in the matrix cell becomes -32767, whatever is input in the Empty Text field is shown.   |
| <b>Hidden Text</b>                    | If the value held in the matrix cell becomes -32768, whatever is input in the Hidden Text field is shown.  |
| <b>Variable type override moniker</b> | This is for historical purposes only and is no longer relevant (the method GetEDVarType is now used internally).   |
| <b>Auto</b>                           | Assigns the appropriate unit according to the specified Moniker and the chosen Unit Set in the Session Preferences.  |
| <b>Moniker</b>                        | <p>This choice allows you to override the selection in the Session Preferences, but also gives the opportunity for the user to make the unit selection at run time. You must specify a moniker to be used when this radio button is selected. This is usually used in conjunction with a Unit data set, which specifies the unit moniker. The same moniker is then used in this unit moniker cell, forming a link between the two cells.</p> <p>A good example is on the Integrator property view, where the user can select a time unit for the integrator step size. The step size, minimum and maximum are then shown in that selected time unit regardless of the choice in the Session Preferences.</p> |
| <b>Fixed</b>                          | Allows you to hard code a particular unit type which overrides the selection in the Session Preferences; for a temperature moniker, you could enter 'C' and have the value always in Celsius; for the format of entries in this field, refer to the unit representations as shown in the Display Units group on the Units page of the Session Preferences property view.   |
| <b>Show Unit in Cell</b>              | Select this checkbox if you want to show the unit associated with the data set Moniker along with the value in the cell.   |
| <b>Hide Units in Label</b>            | Select this checkbox if you want to hide the unit in the data set label.   |

Spreadsheet



| Object                | Description  |
|-----------------------|--|
| Unit System Moniker   | Optional setting. When set it allows the unit set used for the held data to differ from the default "Unit Set" configured in preferences.                                |
| Variable Type Moniker | This is for historical purposes only and is no longer relevant.  |
| Is Formula? Moniker   | Opens the Select Number Variable property view. This allows you to set whether the moniker will be used to get or set either: text (a formula) or numbers (non-formula). |
| Formula Error Moniker | Must return an error code form that indicates what type of mathematical error has occurred or when all is well.  |

Unit



| Object                | Description   |
|-----------------------|---|
| Variable Type Moniker | This is for historical purposes only and is no longer relevant. |

## Worksheet Attach



| Object       | Description   |
|--------------|---|
| Expand Style | <p>There are three options for this drop-down list:</p> <ul style="list-style-type: none"><li>• <b>Always.</b> The default setting. It allows you to automatically expand the worksheet data set to include new entries.</li><li>• <b>Never.</b> This option does not allow you to expand the number of variable entries.</li><li>• <b>Limit.</b> This option allows you to explicitly set the number of entries you can expand to.</li></ul> |

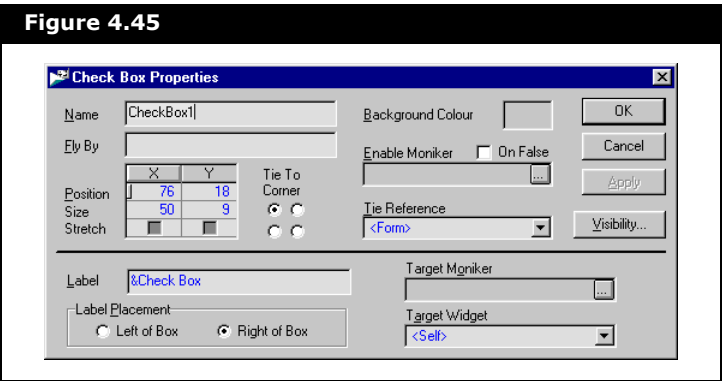
## Numerical Format



| Object         | Description   |
|----------------|---|
| Default Format | <p>This is the variable that represents the default format for the widget. It is called when the user presses either the <b>DELETE</b> key in the widget or the Use Default button on the Real Format Editor property view.</p> |


# 4.3.10 Checkbox Widget

Use this widget for boolean (true/false or yes/no) situations.



## Checkbox Properties

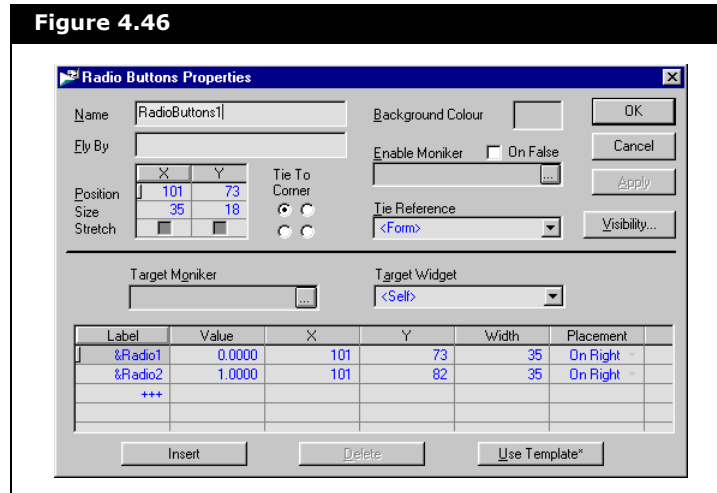
The properties available for a Checkbox widget are described in the table below:

| Object          | Description  |
|-----------------|--|
| Label           | Whatever is entered here is shown as the text next to the checkbox. Place an ampersand (&) before the character that gets the hot key (underscore) designation.  |
| Label Placement | Select a radio button to place the label text to the left or to the right of the checkbox.   |
| Target Moniker  | <p>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real or Enum that you have created in the Object Manager.</p> |
| Target Widget   | <p>By making a selection from this drop-down list, you are instructing the checkbox widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the Text Entry widget.</p>   |

## 4.3.11 Radio Buttons Widget


Use this widget when you want the user to make a single specific choice from a list of mutually exclusive choices (normally a maximum of 3; if more than 3, use an enumeration widget or other appropriate widget).

**Figure 4.46**



## Radio Button Properties

The properties available for a Radio Button widget are described in the table below:

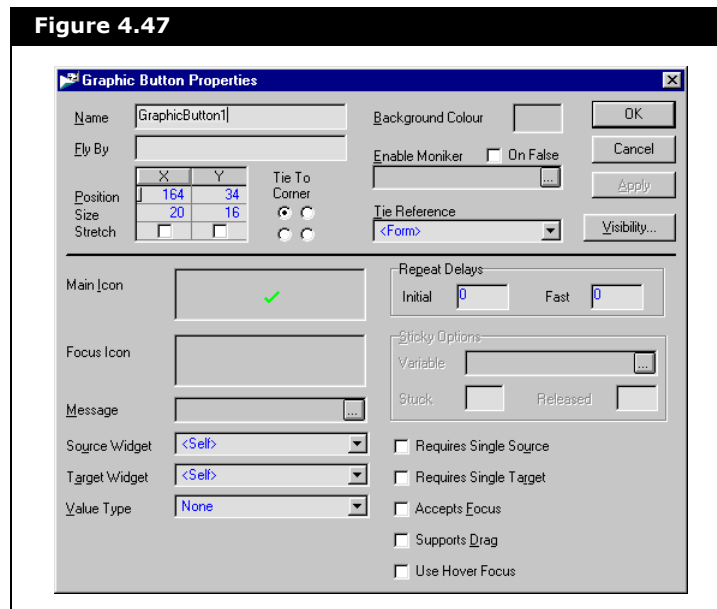
| Object                | Description  |
|-----------------------|--|
| <b>Target Moniker</b> | <p>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real or Enum that you have created in the Object Manager.</p> |
| <b>Target Widget</b>  | <p>By making a selection from this drop-down list, you are instructing the radio buttons widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the text entry widget.</p>  |

| Object                             | Description   |
|------------------------------------|---|
| <b>Insert</b>                      | Adds another entry in to the radio button details matrix wherever the focus happens to be, but the entry will not be named and will have no assigned value. The symbol +++ is shown in the label cell.  |
| <b>Delete</b>                      | Deletes the entry from the radio button details matrix wherever the focus happens to be.  |
| <b>Use Template</b>                | This is not functional.   |
| <b>Radio Button Details Matrix</b> | <p>There are six columns in the matrix in which you can specify details for the radio button widget:</p> <ul style="list-style-type: none"> <li>• <b>Label.</b> Whatever is entered here will be shown as the text next to the radio button. Place an ampersand (&amp;) before the character that will get the hot key (underscore) designation.</li> <li>• <b>Value.</b> Each radio button must have a unique value, such that it can be used in code, if need be. The value can be integer or real, it simply needs to be unique within the scope of the particular widget.</li> <li>• <b>X.</b> X coordinate of the particular radio button on the DefaultView form. For information concerning the units used, refer to the Position section under Common Widget Properties.</li> <li>• <b>Y.</b> Y coordinate of the particular radio button on the DefaultView form. For information concerning the units used, refer to the Position section under Common Widget Properties.</li> <li>• <b>Width.</b> Width of the widget. If you input different values for each radio button, the largest value will be honoured. For information concerning the units used, refer to the Position section under Common Widget Properties.</li> <li>• <b>Placement.</b> Choice for where you want to place the label, in reference to the radio button. Either On Left or On Right.</li> </ul> |

## 4.3.12 Graphic Button Widget

Use this widget to send specific instructions to its base object when it is clicked by the user. More functionality is offered with this widget than with the regular button widget. For instance, you can have a picture appear on the button face and have the button stick in its pressed state.

**Figure 4.47**




## Graphic Button Properties

The properties available for a Graphic Button widget are described in the table below:

| Object            | Description  |
|-------------------|--|
| <b>Main Icon</b>  | Double-click on this cell to make a choice for the icon that will appear on the button.  |
| <b>Focus Icon</b> | Double-click on this cell to make a choice for the icon that will appear with the Main Icon on the button when the button has focus. The default for Focus Icon is the regular dotted outline that appears with most Windows programs. |



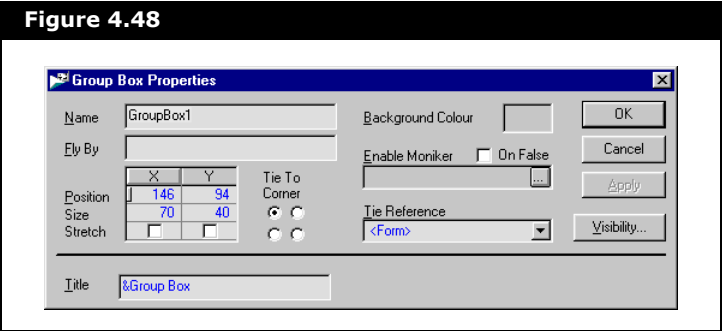
| Object               | Description  |
|----------------------|--|
| <b>Message</b>       | <p>This is the command(s) that will be executed/fired when the button is pressed. For the button shown above, the property view of the upstream unit operation will be shown.</p> <p>You can click the <b>Ellipsis</b> icon  to access the Edit Messages property view, which provides a list of the current messages that are being used for the particular button. From this property view, you can add new messages, delete existing ones, edit the list or re-arrange the order in which the messages are fired. If you have created variables of type Message in the Objects Manager, these will be available for addition to the Edit Messages property view.</p> |
| <b>Source Widget</b> | <p>Allows you to choose a widget that will provide required information when the button is fired. It is used to 'populate' the arguments for the Message. For example, the index value of an object in a list could be provided to the button so the button can perform some action on the particular object. You can use placement holder type syntax (i.e., %d for an integer).</p>  |
| <b>Target Widget</b> | <p>Allows you to choose a widget which holds a collection of objects. The selected object or multiple selected objects will be affected by the firing of the button. For an example, refer to the Target Widget section for the Button widget.</p>   |
| <b>Value Type</b>    | <p>Allows you to choose what type of data is held or passed when the button is pressed. You can choose one of the following:</p> <ul style="list-style-type: none"> <li>• <b>None.</b> The button's only purpose is to fire its message when it is pressed. The <b>View Next Downstream Operation</b> button is an example of the use of this option.</li> <li>• <b>Number.</b> A numeric value is held when the button has been pressed. The <b>Colour Scheme</b> button on the PFD is an example of the use of this option.</li> <li>• <b>Object Type.</b> An object type string is held when the button is pressed. All unit operation and stream buttons on the Object Palette use this option.</li> </ul>   |
| <b>Repeat Delays</b> | <p>In these two fields, Initial and Fast, you can enter values that respectively represent the time that elapses before the first message is sent and the time interval that will pass before the sending of each subsequent message if the button is held down. The units used for the time entries are milliseconds.</p> <p>This is used for the rotation of plots, where the user presses and holds a button down to continually rotate the plot until the desired view is attained.</p>  |

| Object                        | Description   |
|-------------------------------|---|
| <b>Sticky Options</b>         | <p>These options allow you to set whether or not the button will remain in its pressed state (Stuck) when it is pressed and also if it is in its pressed state, whether or not pressing the button again will remove it from its pressed state (Released).</p> <p>You can assign a variable (normally of type Boolean) in the Variable cell to the option, which will allow you to monitor the state of the button (Stuck or Released).</p> <p>By providing values in the Stuck and Released cells, you can assign one of two behaviours for the button:</p> <ul style="list-style-type: none"> <li>Pressing a Stuck button releases the button - provide a unique value in each cell (i.e. 50 and 65)</li> <li>A Stuck button is released by another object - provide the same value in each cell. This behaviour is exhibited by the unit operation and stream buttons on the Objects Palette. For instance, pressing a Cooler operation button will make it stuck. You cannot release the button by pressing it again. You must click the Cancel button (the red X), click the Add button (the green +), click another unit operation or stream button in the palette or click on the PFD to add the operation.</li> </ul> |
| <b>Requires Single Source</b> | Selecting this checkbox limits selection in the source widget to a single item. Continuing the example cited in the Source Widget discussion, selecting this checkbox will allow the user to select only a single fluid package in the list.  |
| <b>Requires Single Target</b> | Selecting this checkbox limits selection in the target widget to a single item. If the button deletes items from a list, you may want to limit the user to only a single deletion per button click.   |
| <b>Accepts Focus</b>          | <p>Select this checkbox if you want the button to take away the focus when it is pressed or to have the ability to accept the focus when its tab order number is selected by pressing the <b>TAB</b> key.</p> <p>For instance, none of the buttons in the PFD toolbar have this checkbox selected, and as such, do not accept the focus when they are pressed. Focus remains with whatever was selected in the PFD. Also, you cannot access the buttons by pressing the <b>TAB</b> key.</p>   |
| <b>Support Drag</b>           | Select this checkbox if the button widget will be drag and drop compliant. All unit operation and stream buttons in the Object Palette have this checkbox selected, and thus, when a button is selected with the secondary mouse button and dragged, the value can be dropped onto another widget (i.e. the PFD).   |

# 4.3.13 Group Widget

Use this widget to organize related information within a titled border on the application’s property view.

Figure 4.48



## Group Properties

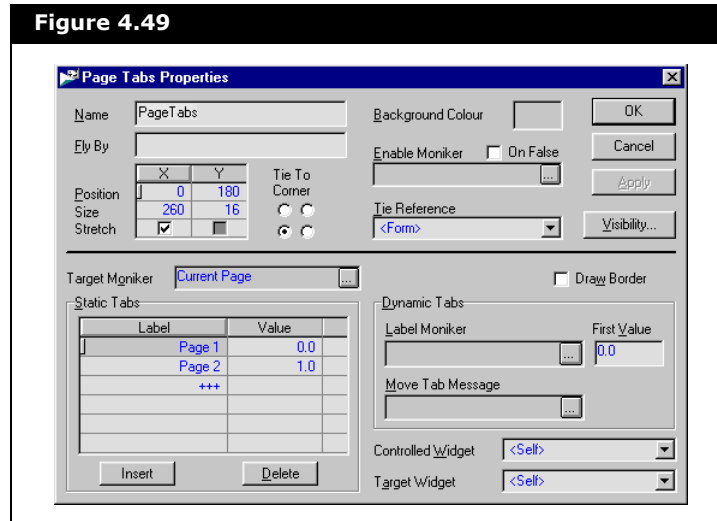
The properties available for a Group widget are described in the table below:

| Object | Description   |
|--------|---|
| Title  | Enter a title for the group. Use the ampersand (&) before the character that is the accelerator key or hot key. |

## 4.3.14 Page Tabs Widget


Use this widget to increase the amount of information that can appear on the application's property view. The widget can then be used in conjunction with the Visibility Manager to organize the information on particular tabs.

**Figure 4.49**



## Page Tab Properties

The properties available for a Tab widget are described in the table below:

| Object                | Description   |
|-----------------------|---|
| <b>Target Moniker</b> | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real or Enum that you have created in the Object Manager. |
| <b>Static Tabs</b>    | In this group, supply a Label and a unique Value for each tab that will appear in this widget.<br>The unique Value that is supplied for each tab should match the High/Low values that you provide in the Visibility Controller Properties property view.   |

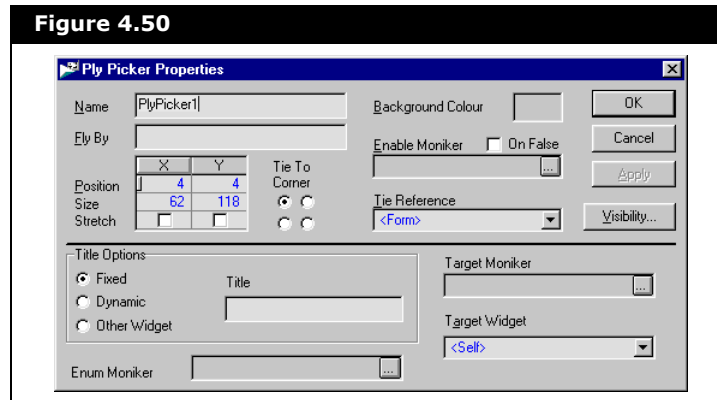
Refer to the [Section 4.2.3 - Visibility Manager](#) for more information.

| Object                   | Description  |
|--------------------------|--|
| <b>Draw Border</b>       | Select this checkbox if you would like a rectangular area around the tabs to have a three-dimensional sunken effect. The tabs in HYSYS do not have this option enabled.  |
| <b>Dynamic Tabs</b>      | <p>There are three areas in this group, each of which deals with the changing of the tabs at run-time:</p> <ul style="list-style-type: none"> <li>• <b>Label Moniker.</b> Supply a variable in this cell if you have to adapt the property view according to user input at run-time. For instance, the results property view for the case study tool in HYSYS has a Label moniker (variable) since the user can create as many case studies as required in the simulation. The property view must show one tab per case study created.</li> <li>• <b>First Value.</b> Provide a unique value in this cell such that the first tab added at run-time does not conflict with any of the values for the static tabs. This value should be greater than the largest unique value that you are using in the Static Tabs group.</li> <li>• <b>Move Tab Message.</b> Allows you to input a custom message, which will be defined in your code, to enable the movement/re-ordering of the tabs at run-time by the user. This functionality is found in the Workbook, where you can select a tab, drag down below the tab and then drag to the side where you would like to move the tab. All tab contents are moved with the tab.</li> </ul> |
| <b>Controlled Widget</b> | <p>The widget selected in this drop-down list will receive the focus when a tab is selected. This functionality provides visual appeal in that the tab seems to be part of the controlled widget. The user does not have to click within the controlled widget after selecting a tab. Normal use of this option occurs when the selected widget is the only other widget on the DefaultView form or when there is a clearly dominant widget that will be the main focus of the user.</p> <p>This functionality is used in the Workbook and in the PFD, in which you can select a particular tab and the focus is automatically placed within the particular Workbook sheet or PFD pane.</p>  |
| <b>Target Widget</b>     | <p>By making a selection from this drop-down list, you are instructing the tabs widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the text entry widget.</p>   |

## 4.3.15 Ply Picker Widget



This widget, used in conjunction with the tabs widget, provides a way to further organize information while retaining a clean look for the application's property view. With an enormous amount of information, using this widget avoids the creation of tabs in the double digits on a single property view.

**Figure 4.50**



## Ply Picker Properties

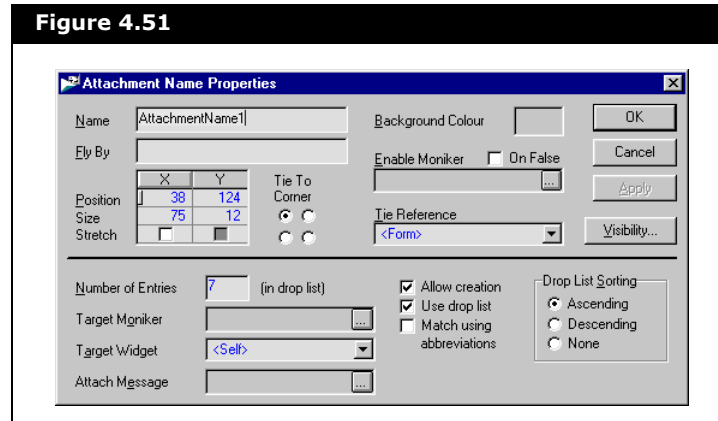
The properties available for a Page Picker widget are described in the table below:

| Object                | Description   |
|-----------------------|---|
| <b>Title Options</b>  | <p>In this group you can provide a title for the ply picker widget. Refer to the example widget shown previously, which has the title Design, to see where the title is placed.</p> <p>You see a different input cell in this group depending on the radio button selection. The radio button selections are:</p> <ul style="list-style-type: none"> <li>• <b>Fixed.</b> Choose this option if you want to supply a static title, and then supply the text in the Title input cell.</li> <li>• <b>Dynamic.</b> If you would like the title to be dynamic (i.e. ability to change at run-time), select this option and then associate the title with a variable in the Title Moniker cell. Any variables of type Text that you have created in the Object Manager will be shown when you click the <b>Ellipsis</b> icon .</li> <li>• <b>Other Widget.</b> Select this option if you want to choose a widget that will supply the ply picker title with information. You can then select a widget from the Source Widget drop-down list. For example, you could select the tabs widget and have the tab label appear as the ply picker title widget. This is how the ply picker widget on the HYSYS unit operation property views are configured.</li> </ul> |
| <b>Enum Moniker</b>   | <p>Allows you to associate an enumeration variable to the widget so that the name of each individual 'ply' can appear on the widget. For example, the widget shown previously, the enumeration contains the names Connections, Parameters, User Variables and Notes.</p>  |
| <b>Target Moniker</b> | <p>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real or Enum that you have created in the Object Manager.</p>  |
| <b>Target Widget</b>  | <p>By making a selection from this drop-down list, you are instructing the ply picker widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the Text Entry widget.</p>  |

## 4.3.16 Attachment Name Widget


Use this widget to display variables of type **Attachment** in a drop-down list format.

**Figure 4.51**



## Attachment Name Properties

The properties available for a Attachment Name widget are described in the table below:

| Object                   | Description   |
|--------------------------|---|
| <b>Number of Entries</b> | In this cell, you specify the size of the list that is shown when the drop-down list is accessed. If more objects exist than the value specified, a scroll bar is automatically added to the drop-down list.  |
| <b>Target Moniker</b>    | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Attachment that you have created in the Object Manager. |
| <b>Target Widget</b>     | By making a selection from this drop-down list, you are instructing the attachment name widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br>For an example, see the Target Widget property for the Text Entry widget.  |

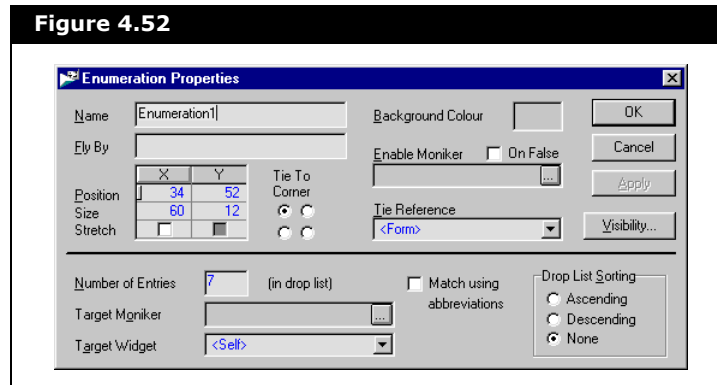


| Object                           | Description   |
|----------------------------------|---|
| <b>Attach Message</b>            | Allows you to specify a command(s) that will be executed/fired when a choice is made in the attachment name widget. All variables of type Message that you created in the Objects Manager will be available if you click the Ellipsis and then click the Insert button on the Edit Messages property view.  |
| <b>Allow creation</b>            | Select this checkbox if you want the user to be able to type directly in the attachment name widget and have the application create a new object of type Attachment with the user input name.<br><br>Most unit operation property views that have attachment name widgets will allow the creation of a new attached stream when the user types a name directly in the widget.                           |
| <b>Use drop list</b>             | Select this checkbox if you want the widget to show its drop-down list when selected. If this checkbox is cleared, the widget appears as though it is a text entry widget.  |
| <b>Match using abbreviations</b> | Select this checkbox if you want the focus in the drop-down list to move to the first occurrence of the letter or letter combination that the user types.<br><br>This checkbox is available only when the <b>Use drop list</b> checkbox is selected.  |
| <b>Drop List Sorting</b>         | Select one of the radio buttons to instruct the widget on how you would like the items in the drop-down list shown: <ul style="list-style-type: none"> <li>• <b>Ascending.</b> Items are shown alphabetically.</li> <li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li> <li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li> </ul> |

## 4.3.17 Enumeration Widget


Use this widget to display a list of names in a drop-down list format.

**Figure 4.52**



## Enumeration Properties

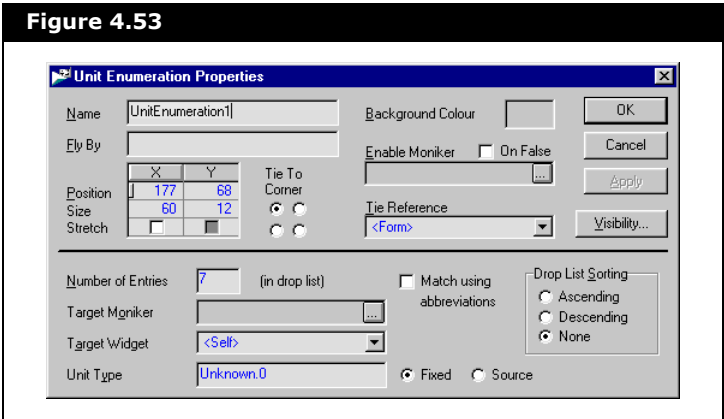
The properties available for a Enumeration widget are described in the table below:

| Object                   | Description  |
|--------------------------|--|
| <b>Number of Entries</b> | In this cell, you specify the size of the list that is shown when the drop-down list is accessed. If more objects exist than the value specified, a scroll bar is automatically added to the drop-down list.   |
| <b>Target Moniker</b>    | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Enumeration that you have created in the Object Manager. |
| <b>Target Widget</b>     | By making a selection from this drop-down list, you are instructing the enumeration widget to receive its information from the <b>Target Widget</b> . When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br>For an example, see the Target Widget property for the Text Entry widget.   |

| Object                    | Description   |
|---------------------------|---|
| Match using abbreviations | Select this checkbox if you want the focus in the drop-down list to move to the first occurrence of the letter or letter combination that the user types.   |
| Drop List Sorting         | Select one of the radio buttons to instruct the widget on how you would like the items in the drop-down list shown: <ul style="list-style-type: none"><li>• <b>Ascending.</b> Items are shown alphabetically.</li><li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li><li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li></ul> |


# 4.3.18 Unit Enumeration Widget

Use this widget to display a list of units in a drop-down list format.



## Unit Enumeration Properties

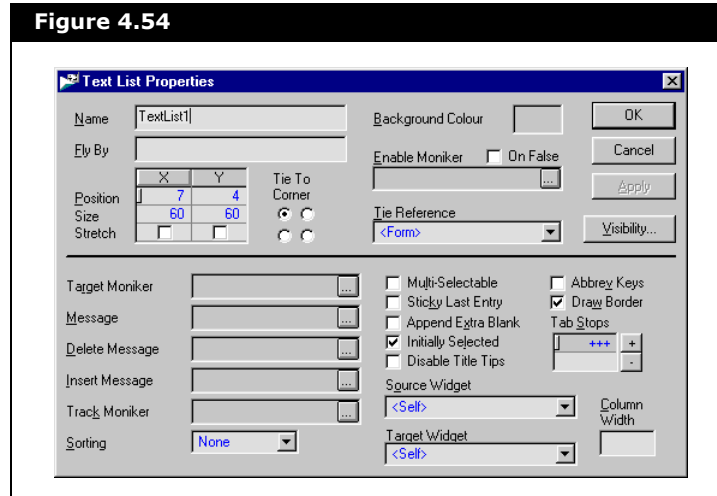
The properties available for a Unit Enumeration widget are described in the table below:

| Object                                  | Description  |
|---|--|
| <b>Number of Entries</b>                | In this cell, you specify the size of the list that is shown when the drop-down list is accessed. If more objects exist than the value specified, a scroll bar is automatically added to the drop-down list.   |
| <b>Target Moniker</b>                   | <p>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Text that you have created in the Object Manager.</p> |
| <b>Target Widget</b>                    | <p>By making a selection from this drop-down list, you are instructing the unit enumeration widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the text entry widget.</p>   |
| <b>Unit Type/<br/>Unit Type Moniker</b> | This cell along with its corresponding radio buttons (Fixed and Source) are for historical purposes only.  |
| <b>Match using abbreviations</b>        | Select this checkbox if you want the focus in the drop-down list to move to the first occurrence of the letter or letter combination that the user types.  |
| <b>Drop List Sorting</b>                | <p>Select one of the radio buttons to instruct the widget on how you would like the items in the drop-down list shown:</p> <ul style="list-style-type: none"> <li>• <b>Ascending.</b> Items are shown alphabetically.</li> <li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li> <li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li> </ul>   |

## 4.3.19 Text List Widget


Use this widget to display a list of object related information in text format, from which the object can usually be accessed.

**Figure 4.54**



## Text List Properties

The properties available for a Text List widget are described in the table below:

| Object                | Description  |
|-----------------------|--|
| <b>Target Moniker</b> | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Text that you created in the Objects Manager. Any variables of type Text that you create must have Vector selected in the N Dimensions drop-down list. |
| <b>Message</b>        | This is the message that is executed/sent when the user presses <b>ENTER</b> or double-clicks on the selection in the widget. Normal use would have the object's property view open.   |
| <b>Delete Message</b> | This is the message that will be executed/fired when the user presses <b>DELETE</b> on the selection in the widget. Normal use would have the object being deleted.  |
| <b>Insert Message</b> | This is the message that will be executed/fired when the user presses <b>INSERT</b> while the focus is within the widget.  |

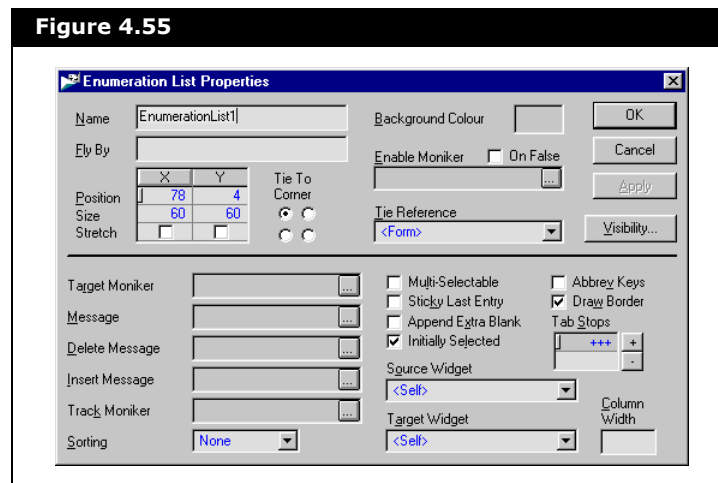
| Object                    | Description   |
|---------------------------|---|
| <b>Track Moniker</b>      | Supply a variable in this cell which will allow you to keep a record of the selected object in the list or set the selected object in the list, depending on how it is used in your code. When there is multiple selection in the list, the first (topmost) object in the selection will be accessed through the track moniker. The track moniker will not correspond to the object that has focus when multiple selection is made from the top down, as the bottom most object will have the dotted outline or focus.  |
| <b>Sorting</b>            | Select one of the options in the drop-down list to instruct the widget on how you would like the items in the widget to be shown: <ul style="list-style-type: none"> <li>• <b>Ascending.</b> Items are shown alphabetically.</li> <li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li> <li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li> </ul>   |
| <b>Multi-Selectable</b>   | Select this checkbox if you want to allow more than a single selection in the widget.   |
| <b>Sticky Last Entry</b>  | If this checkbox is selected, placing the focus on the last entry will keep the focus on the last entry in the widget even when additions are being made to the widget. Refer to this option in the Matrix widget for an example.   |
| <b>Append Extra Blank</b> | Select this checkbox if you want a blank row to always be present at the end of the list. This is useful when the user is able to select the position of new entrants to the list. By placing the focus on the blank row at the end, the new list entrant will added to the end of the list. Placing the focus on an existing list entry will have the new list entrant added above this selection. This behaviour is exhibited in the Current Component List on the Components tab of the Fluid Package property view. |
| <b>Initially Selected</b> | Select this checkbox if you want to have an item selected in the widget when the property view is re-opened. This option retrieves the list item identified in the track moniker and tries to match this information to an item that you may have coded (i.e. by name). If no match is found, the first item in the list becomes the selected item and this information is sent to the track moniker. A selected item does not necessarily have the focus.  |
| <b>Source Widget</b>      | Allows you to choose a widget that will provide required information when any message is fired. It is used to 'populate' the arguments for a message.   |
| <b>Target Widget</b>      | By making a selection from this drop-down list, you are instructing the text list widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br><br>For an example, see the Target Widget property for the text entry widget.  |
| <b>Abbrev Keys</b>        | Select this checkbox if you want the focus in the list to move to the first occurrence of the letter or letter combination that the user types.   |

| Object              | Description   |
|---------------------|---|
| <b>Draw Border</b>  | Select this checkbox if you would like a rectangular area around the text list to have a three-dimensional sunken effect.   |
| <b>Tab Stops</b>    | Add values here which correspond to the use of '\t', the tab character, in the text strings that will populate the text list widget.<br><br>If there are two occurrences of the tab character in the text strings that will fill the widget, there should be two tab stops, indicating the position to start the string after the tab. With 2 tab stops, it will seem as though there are three columns of information in the text list widget. |
| <b>Column Width</b> | If you provide a value (the width of each column) in this cell, list entries will wrap to the right in to a new column when the current widget size has been reached. If no value is provided, the list will keep expanding in a single column with the appearance of scroll bars when the widget height has been reached.  |

## 4.3.20 Enumeration List Widget


Use this widget to display a list of the labels in an enumeration.

**Figure 4.55**



## Enumeration List Properties

The properties available for a Enumeration List widget are described in the table below:

| Object                   | Description  |
|--------------------------|--|
| <b>Target Moniker</b>    | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br><br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Enumeration that you created in the Objects Manager.   |
| <b>Message</b>           | This is the message that is executed/sent when the user presses <b>ENTER</b> or double-clicks on the selection in the widget. Normal use would have the object's property view open.   |
| <b>Delete Message</b>    | This is the message that will be executed/fired when the user presses <b>DELETE</b> on the selection in the widget. Normal use would have the object being deleted.  |
| <b>Insert Message</b>    | This is the message that will be executed/fired when the user presses <b>INSERT</b> while the focus is within the widget.  |
| <b>Track Moniker</b>     | Supply a variable in this cell which will allow you to keep a record of the selected object in the list or set the selected object in the list, depending on how it is used in your code. When there is multiple selection in the list, the first (top most) object in the selection will be accessed through the track moniker. The track moniker will not correspond to the object that has focus when multiple selection is made from the top down, as the bottommost object will have the dotted outline or focus. |
| <b>Sorting</b>           | Select one of the options in the drop-down list to instruct the widget on how you would like the items in the widget to be shown: <ul style="list-style-type: none"> <li>• <b>Ascending.</b> Items are shown alphabetically.</li> <li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li> <li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li> </ul>  |
| <b>Multi-Selectable</b>  | Select this checkbox if you want to allow more than a single selection in the widget.  |
| <b>Sticky Last Entry</b> | If this checkbox is selected, placing the focus on the last entry will keep the focus on the last entry in the widget even when additions are being made to the widget. Refer to this option in the Matrix widget for an example.  |

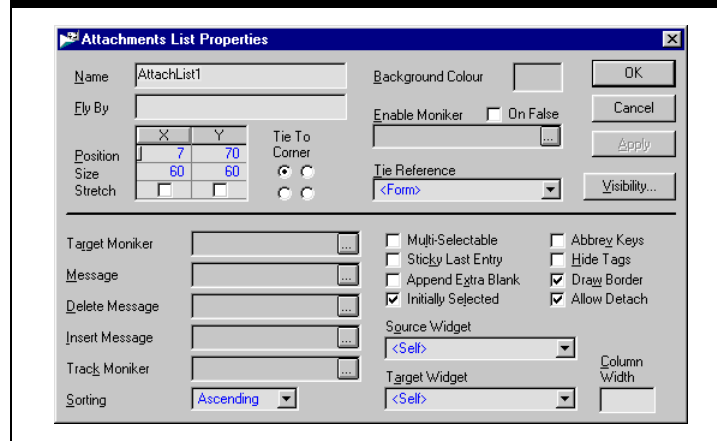


| Object                    | Description  |
|---------------------------|--|
| <b>Append Extra Blank</b> | Select this checkbox if you want a blank row to always be present at the end of the list. This is useful when the user is able to select the position of new entrants to the list. By placing the focus on the blank row at the end, the new list entrant will be added to the end of the list. Placing the focus on an existing list entry will have the new list entrant added above this selection. This behaviour is exhibited in the Current Component List on the Components tab of the Fluid Package property view. |
| <b>Initially Selected</b> | Select this checkbox if you want to have an item selected in the widget when the property view is re-opened. This option retrieves the list item identified in the track moniker and tries to match this information to an item that you may have coded (i.e. by name). If no match is found, the first item in the list becomes the selected item and this information is sent to the track moniker. A selected item does not necessarily have the focus.   |
| <b>Source Widget</b>      | Allows you to choose a widget that will provide required information when any message is fired. It is used to 'populate' the arguments for a message.  |
| <b>Target Widget</b>      | By making a selection from this drop-down list, you are instructing the enumeration list widget to receive its information from the <b>Target Widget</b> . When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br><br>For an example, see the Target Widget property for the text entry widget.  |
| <b>Abbrev Keys</b>        | Select this checkbox if you want the focus in the list to move to the first occurrence of the letter or letter combination that the user types.  |
| <b>Draw Border</b>        | Select this checkbox if you would like a rectangular area around the enumeration list to have a three-dimensional sunken effect.   |
| <b>Tab Stops</b>          | Add values here which correspond to the use of '\t', the tab character, in the enumeration labels that will populate the enumeration list widget.<br><br>If there are two occurrences of the tab character in the enumeration labels that will fill the widget, there should be two tab stops, indicating the position to start the label after the tab. With 2 tab stops, it will seem as though there are three columns of information in the enumeration list widget.   |
| <b>Column Width</b>       | If you provide a value (the width of each column) in this cell, list entries will wrap to the right in to a new column when the current widget size has been reached. If no value is provided, the list will keep expanding in a single column with the appearance of scroll bars when the widget height has been reached.   |

## 4.3.21 Attachment List Widget


Use this widget to display a list of related objects.

**Figure 4.56**



## Attachment List Properties

The properties available for a Attachment List widget are described in the table below:

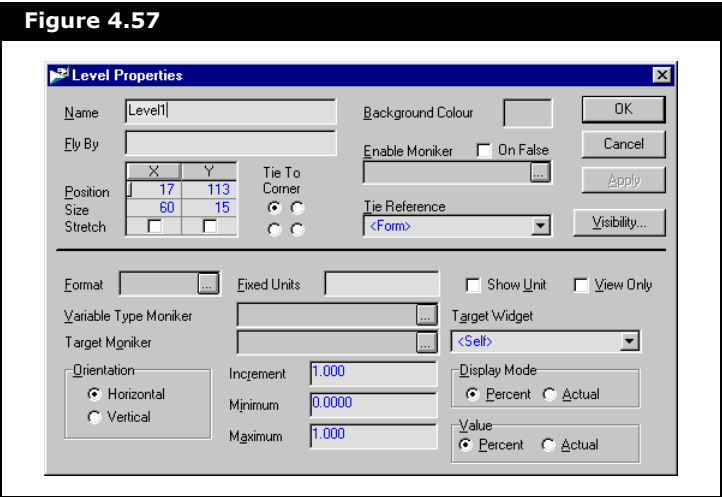
| Object                | Description  |
|-----------------------|--|
| <b>Target Moniker</b> | This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.<br><br>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Attachment that you created in the Objects Manager. Any variables of type Attachment that you create must have Vector selected in the N Dimensions drop-down list. |
| <b>Message</b>        | This is the message that is executed/sent when the user presses <b>ENTER</b> or double-clicks on the selection in the widget. Normal use would have the object's property view open.   |
| <b>Delete Message</b> | This is the message that will be executed/fired when the user presses <b>DELETE</b> on the selection in the widget. Normal use would have the object being deleted.  |
| <b>Insert Message</b> | This is the message that will be executed/fired when the user presses <b>INSERT</b> while the focus is within the widget.  |

| Object                    | Description  |
|---------------------------|--|
| <b>Track Moniker</b>      | Supply a variable in this cell which will allow you to keep a record of the selected object in the list or set the selected object in the list, depending on how it is used in your code. When there is multiple selection in the list, the first (topmost) object in the selection will be accessed through the track moniker. The track moniker will not correspond to the object that has focus when multiple selection is made from the top down, as the bottommost object will have the dotted outline or focus.      |
| <b>Sorting</b>            | Select one of the options in the drop-down list to instruct the widget on how you would like the items in the widget to be shown: <ul style="list-style-type: none"> <li>• <b>Ascending.</b> Items are shown alphabetically.</li> <li>• <b>Descending.</b> Items are shown in reverse alphabetical order.</li> <li>• <b>None.</b> Items are shown in the order in which they are added to the application.</li> </ul>  |
| <b>Multi-Selectable</b>   | Select this checkbox if you want to allow more than a single selection in the widget.  |
| <b>Sticky Last Entry</b>  | If this checkbox is selected, placing the focus on the last entry will keep the focus on the last entry in the widget even when additions are being made to the widget. Refer to this option in the Matrix widget for an example.  |
| <b>Append Extra Blank</b> | Select this checkbox if you want a blank row to always be present at the end of the list. This is useful when the user is able to select the position of new entrants to the list. By placing the focus on the blank row at the end, the new list entrant will be added to the end of the list. Placing the focus on an existing list entry will have the new list entrant added above this selection. This behaviour is exhibited in the Current Component List on the Components tab of the Fluid Package property view. |
| <b>Initially Selected</b> | Select this checkbox if you want to have an item selected in the widget when the property view is re-opened. This option retrieves the list item identified in the track moniker and tries to match this information to an item that you may have coded (i.e. by name). If no match is found, the first item in the list becomes the selected item and this information is sent to the track moniker. A selected item does not necessarily have the focus.   |
| <b>Source Widget</b>      | Allows you to choose a widget that will provide required information when any message is fired. It is used to 'populate' the arguments for a message.  |
| <b>Target Widget</b>      | By making a selection from this drop-down list, you are instructing the attachment list widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.<br><br>For an example, see the Target Widget property for the text entry widget.   |
| <b>Abbrev Keys</b>        | Select this checkbox if you want the focus in the list to move to the first occurrence of the letter or letter combination that the user types.  |

| Object              | Description   |
|---------------------|---|
| <b>Hide Tags</b>    | <p>Select this checkbox if you do not want to show name of the flowsheet with the name of the object in the list. The flowsheet name will only appear when the object is being shown outside its home flowsheet.</p> <p>For instance, in a list of material streams, a stream representing the reflux to a column, which is internal to the column environment, may appear in a list in the main flowsheet as Reflux@COL1 if the <b>Hide Tags</b> checkbox is cleared. With this checkbox selected, the user would only see Reflux.</p> |
| <b>Draw Border</b>  | Select this checkbox if you would like a rectangular area around the attachment list to have a three-dimensional sunken effect.   |
| <b>Allow Detach</b> | Select this checkbox if you want the object pointer to be replaced by NULL when the attachment is deleted. If this option is used, the code must account for this scenario. The Allow Detach option is only valid when the Delete Message is not being used.  |
| <b>Column Width</b> | If you provide a value (the width of each column) in this cell, list entries will wrap to the right in to a new column when the current widget size has been reached. If no value is provided, the list will keep expanding in a single column with the appearance of scroll bars when the widget height has been reached.  |


# 4.3.22 Level Widget

Use this widget to display a numerical value along with a graphical representation of the value as a percentage of its full range.




## Level Properties

The properties available for a Level widget are described in the table below:

| Object                       | Description  |
|------------------------------|--|
| <b>Format</b>                | Specify the format for the value in the widget.<br>Clicking the <b>Ellipsis</b> icon  brings up the Real Format Editor property view.                         |
| <b>Fixed Units</b>           | Enter a unit here if you want to force the value in the widget to remain as this unit type regardless of the unit set selection in the Session Preferences. For a temperature moniker, you could enter 'C' and have the value always in Celsius. |
| <b>Variable Type Moniker</b> | This is for historical purposes only and is no longer relevant (the method GetEDVarType is used internally).   |

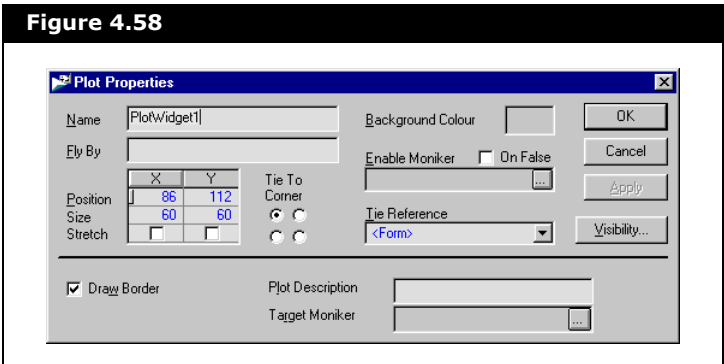
For information concerning the format of entries in this field, refer to **Section 12.3.1 - Units Page** from the **HYSYS User Guide**.

| Object                | Description  |
|-----------------------|--|
| <b>Target Moniker</b> | <p>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</p> <p>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real Number or Enumeration that you have created in the Object Manager.</p>   |
| <b>Orientation</b>    | <p>The radio button selection in this group provides instructions on how to draw the graphical portion of the widget. The choices are:</p> <ul style="list-style-type: none"> <li>• <b>Horizontal.</b> The line representing the current value in the range will be vertical. The use of Horizontal stems from the fact that the 'used' portion and 'unused' portion of the range are seen one beside the other.</li> <li>• <b>Vertical.</b> The line representing the current value in the range will be horizontal. The use of Vertical stems from the fact that the 'used' portion and 'unused' portion of the range are seen one above the other.</li> </ul> |
| <b>Increment</b>      | <p>Enter a value here which is used as the incremental step size when the current value pointer is dragged in the level widget. For the OP cell in a face plate, you can click on the current value (when the controller is in Manual) with the mouse and drag the line to a new output value. The increment value for the OP cell is 0.01.</p>  |
| <b>Minimum</b>        | <p>The Minimum cell as shown has no relevance. Both the Minimum and Maximum values in the target moniker range should be determined through monikers or through the code.</p>  |
| <b>Maximum</b>        | <p>The Maximum cell as shown has no relevance. Both the Minimum and Maximum values in the target moniker range should be determined through monikers or through the code.</p>  |
| <b>Show Unit</b>      | <p>Select this checkbox if you want to show the unit associated with the moniker with the value in the widget.</p>   |
| <b>View Only</b>      | <p>Select this checkbox to make the widget read-only.</p>  |
| <b>Target Widget</b>  | <p>By making a selection from this drop-down list, you are instructing the level widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the Text Entry widget.</p>  |

| Object              | Description   |
|---------------------|---|
| <b>Display Mode</b> | <p>The display mode represents the graphical portion of the widget. Select either radio button:</p> <ul style="list-style-type: none"><li>• <b>Percent.</b> The graphical bar representing the current value in the level widget will be shown at the percentage value in the range. If you are monitoring a temperature between 0 and 200°C, and the current value is 20°C, the bar shows up at the 10% point in the range.</li><li>• <b>Actual.</b> The graphical bar representing the current value in the level widget will be shown at the current value in the range. If you are monitoring a temperature between 0 and 200°C, and the current value is 20°C, the bar shows up at the 20°C point in the range.</li></ul> <p>It is recommended that you select the same radio button choice in both the Display Mode and the Value groups.</p> |
| <b>Value</b>        | <p>The value represents the numeric value shown in the widget. Select either radio button:</p> <ul style="list-style-type: none"><li>• <b>Percent.</b> The numeric value in the level widget is shown as the percentage value in the range. If you are monitoring a temperature between 0 and 200°C, and the current value is 20°C, you see 10 in the widget representing 10% of the range.</li><li>• <b>Actual.</b> The numeric value in the level widget is shown as the actual value in the range. If you are monitoring a temperature between 0 and 200°C, and the current value is 20°C, you see 20°C in the widget.</li></ul> <p>It is recommended that you select the same radio button choice in both the Display Mode and the Value groups.</p>  |


# 4.3.23 Plot Widget

Use this widget to show a two-dimensional or three-dimensional graph. The appropriate plot is shown according to the values sent through code.



## Plot Properties

The properties available for a Plot widget are described in the table below:

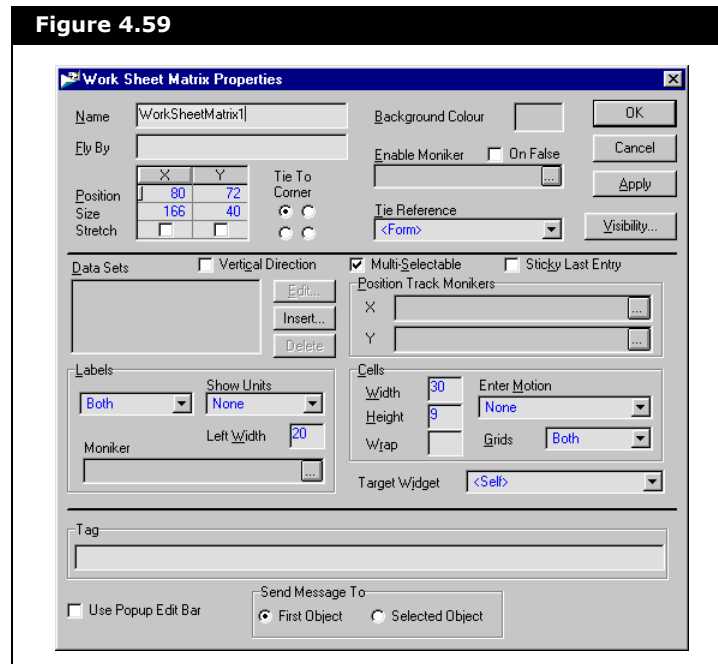
| Object                  | Description  |
|-------------------------|--|
| <b>Draw Border</b>      | Select this checkbox if you would like a rectangular area around the plot to have a three-dimensional sunken effect.   |
| <b>Plot Description</b> | Enter a description (with no spaces in the name) here such that you can access the widget through code.  |
| <b>Target Moniker</b>   | <div>This is the variable to which you put your widget data and/or from which you get your widget data. It is the variable that is associated with the widget.</div> <div>Clicking the <b>Ellipsis</b> icon  gives a list of available options, including any variables of type Real Number or Enumeration that you have created in the Object Manager.</div> |



## 4.3.24 Worksheet Matrix Widget

Use this widget to display related information in an organized fashion. The Worksheet Matrix provides all the functionality of the Matrix widget in addition to the built-in run-time wrapping capabilities.

**Figure 4.59**



**When a Worksheet Matrix (in other words, the Workbook matrix) is resized by the user, the number of columns dynamically change according to the current size of the property view.**

## Worksheet Matrix Properties

The properties available for a Worksheet Matrix widget are described in the table below:

For more information on the data set type properties see [DataSet Properties](#) found in [Section 4.3.9 - Matrix Widget](#).

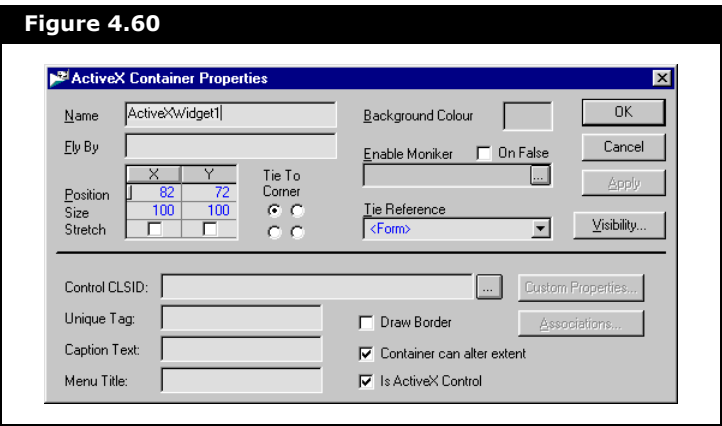
| Object                         | Description   |
|--------------------------------|---|
| <b>Data Sets</b>               | <p>In this list, you can Edit or Delete a selected data set or Insert a new data set by clicking the appropriate button. The View Editor requires a minimum of one data set at all times for the worksheet matrix widget.</p> <p>When the Insert button is clicked, you must choose the type of data set from the Select a Data Type property view. Each type has its own set of properties. Only the most frequently used data set types are described:</p> <ul style="list-style-type: none"> <li>• <b>Attachment.</b> For objects such as streams, pump curves, etc.</li> <li>• <b>Boolean.</b> Displays a checkbox (or other designated symbol) for true/false type situations.</li> <li>• <b>Enumeration.</b> Shows the enumeration label for the given enumeration value.</li> <li>• <b>Numeric.</b> For any numeric value, real or integer.</li> <li>• <b>Text.</b> For text values or labels.</li> <li>• <b>Unit.</b> Used to show and specify the unit being used (i.e., for time units, choose between seconds, minutes, hours, etc.) for other data in the matrix; provides a link for overriding the Session Preferences unit set for other matrix data.</li> </ul> |
| <b>Vertical Direction</b>      | If this checkbox is selected, data sets are added one below the next (vertical direction).  |
| <b>Multi-Selectable</b>        | If this checkbox is selected, you are able to select multiple cells in the matrix, horizontally, vertically and diagonally.   |
| <b>Sticky Last Entry</b>       | If this checkbox is selected, placing the focus on the last entry will keep the focus on the last entry in the matrix even when additions are being made to the matrix. For instance, while the solver is performing iterations, run time data can enter a matrix. If you always wanted to see the last entry in the list, you would select the <b>Sticky Last Entry</b> checkbox and place the focus on the last entry in the matrix. Placing the focus anywhere but on the last entry will keep the focus on that particular entry, which is also the behaviour which will be exhibited if the checkbox is cleared.   |
| <b>Position Track Monikers</b> | Allows you to assign different monikers to the x and y locations in the matrix so you can keep track of the exact location of the focus. An example of this functionality is in the Workbook. The Show Name Only button compresses all the stream information to show only the names of the streams. The current focus can be on any of the stream properties (i.e. name, temperature, molar flow) when uncompressed information is shown. When the Show Name Only button is clicked the focus moves to the name of the stream that held the focus, which would be a different row number.  |

| Object              | Description   |
|---------------------|---|
| <b>Labels</b>       | <p>The Labels group has two drop-down lists, a numerical entry cell and a cell for a label moniker:</p> <ul style="list-style-type: none"> <li>• <b>Unnamed.</b> The first option is unnamed, but allows you to choose where you would like labels shown in the matrix. Your options are None, Row (place the labels in the left column of each row), Column (place the labels along the top row on each column) and Both.</li> <li>• <b>Show Units.</b> A drop-down list which you can choose to display units along with label on the Row, in the Column or on Both or choose None. This will likely coincide with your choice of whether or not to display units.</li> </ul>   |
| <b>Cells</b>        | <p>In this group, you can set global Width, Height and Wrap values for the worksheet matrix widget. The cell width can be overridden in the individual data set properties. The cell height of 9 is the standard that is used in all HYSYS property views. The value for Wrap allows you to force a particular number of columns of data to be displayed in the matrix. After this value is reached the next column of data will start at the far left. An example of this behaviour is on the Worksheet tab of the Column unit operation (its value is set to 5).</p>  |
| <b>Enter Motion</b> | <p>Select a direction for the focus movement when the <b>ENTER</b> key has been pressed in the matrix. The options include:</p> <ul style="list-style-type: none"> <li>• <b>None.</b> Stay in the same cell.</li> <li>• <b>Right.</b> Move to the cell to the right.</li> <li>• <b>Down.</b> Move to the cell directly below.</li> <li>• <b>Complement.</b> Move to the complementary matrix cell (i.e. if focus is in row 2, column 4 move to row 4, column 2). An example of this behaviour is in the binary coefficients matrix for the Chien Null activity model.</li> <li>• <b>Right Wrap.</b> Use this option in conjunction with the <b>Wrap</b> cell. When data in the last cell of the rightmost column has been input, the focus moves to the next line in the leftmost column. This is used in the property view for molecular weight/density/viscosity assay data input.</li> <li>• <b>Right if Empty.</b> If the value in the cell was <b>&lt;empty&gt;</b> before input, then move to the right; if it held a value and the user is simply editing, then stay in that cell.</li> <li>• <b>Down if Empty.</b> If the value in the cell was <b>&lt;empty&gt;</b> before input, then move down one cell; if it held a value and the user is simply editing, then stay in that cell.</li> <li>• <b>Complement if Empty.</b> If the value in the cell was <b>&lt;empty&gt;</b> before input, then move to the complementary matrix cell; if it held a value and the user is simply editing, then stay in that cell.</li> </ul> |

| Object        | Description  |
|---------------|--|
| Grids         | Specify whether you want the matrix grid shown for each Column, each Row, Both rows and columns or None at all.  |
| Target Widget | <p>By making a selection from this drop-down list, you are instructing the worksheet matrix widget to receive its information from the Target Widget. When a target widget is selected, the target moniker must correspond to a variable associated with the target widget.</p> <p>For an example, see the Target Widget property for the Text Entry widget.</p> |


# 4.3.25 ACTIVEX Container Widget

This widget allows you to incorporate ActiveX objects in to your DefaultView form.



## ActiveX Container Properties

The properties available for a ActiveX Container widget are described in the table below:

| Object                            | Description   |
|-----------------------------------|---|
| <b>Control CLSID</b>              | Clicking the <b>Ellipsis</b> icon  opens the Select an ActiveX Control property view which displays a list of ActiveX Controls. Selecting a control inserts the Class Identity currently available on your computer. |
| <b>Custom Properties</b>          | Clicking this button displays the custom properties associated with the ActiveX Control.<br>The Control CLSID field must first be selected before this button can be used.  |
| <b>Associations</b>               | Opens the Set Associations with ActiveX Properties and Events that allows you to tie the control to an event or the custom properties to a variable.<br>The Control CLSID field must first be selected before this button can be used.  |
| <b>Unique Tag</b>                 | This the internal designation of the control.   |
| <b>Caption Text</b>               | The text associated with the control.   |
| <b>Menu Title</b>                 | The text label that appears in the menu bar when the control has focus.   |
| <b>Draw Border</b>                | Draws a border around the ActiveX Control.  |
| <b>Container can alter extent</b> | This checkbox is for internal use only and should not go unchecked.   |

# 5 User Variables

|  |           |
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## 5.1 Introduction

User Variables help you to increase the internal functionality of HYSYS objects, such as streams and unit operations, by dynamically attaching variables and code to those objects from within HYSYS itself. User Variables are indistinguishable from the variables built into HYSYS objects and, as such, can be added to spreadsheets, targeted by logic controllers, have their values specified by your input, etc.

For example, you could attach a User Variable to a stream to ensure that the flow rate is specified lower than a certain value. Or, you could have a property view appear when a vessel temperature exceeds a certain value.

User Variables let you attach code written in a Visual Basic<sup>®</sup> compatible macro language to simulation objects and specify when that code is to execute. In doing so, you have a simple means of adding extra functionality to any HYSYS simulation.

## 5.2 Adding a User Variable

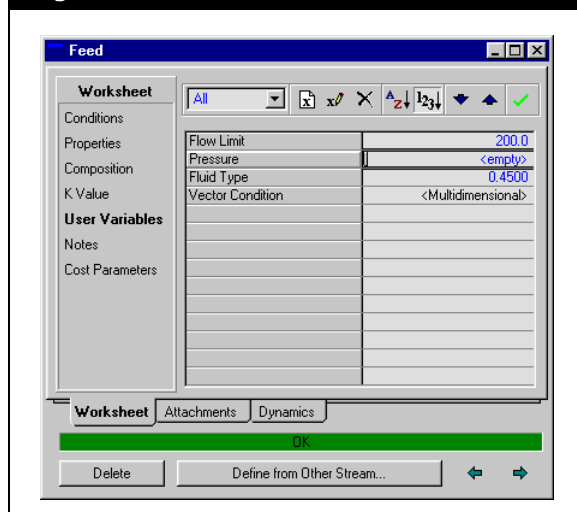
You can add User Variables on three levels within your case:

- **Flowsheet Object.**

User Variables can be added to most HYSYS flowsheet objects in the User Variables matrix located on the **User Variables** page or the **User Variables** tab, of the object's property view.

Regardless of where the User Variables matrix is located, the matrix is the same as the one shown in the figure below.

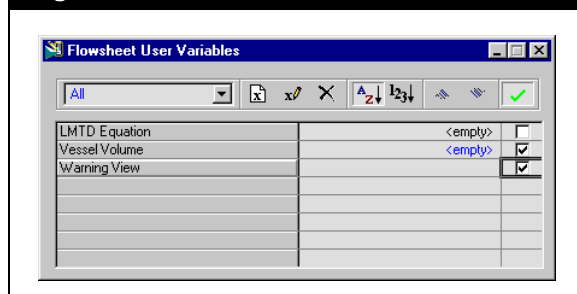
**Figure 5.1**



- **Flowsheet.**

If you want to attach a User Variable to the flowsheet on which you are working, open the **Flowsheet** menu in the menu bar and select **Flowsheet User Variables** command.

**Figure 5.2**

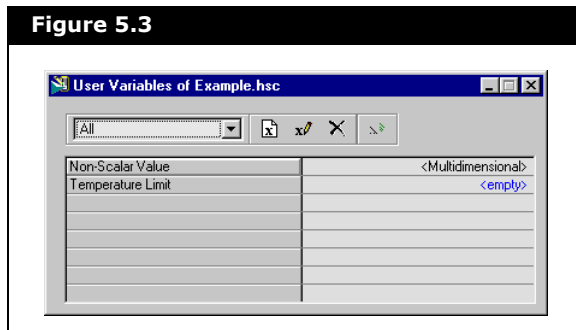




- **Simulation.**

If you want to add a User Variable to your simulation, open the **Simulation** menu in the menu bar and select **Simulation User Variables** command.

**Figure 5.3**



The User Variables property view contains all the User Variables currently attached to the object. There is a drop-down list that serves as a filter to sort the displayed User Variables by Data Type.

**There is no User Variables page or tab attached directly to the Column property view. User Variables can be attached to the individual components of the Column (tray section, reboiler etc.) only when you are in the column sub-flowsheet environment.**









The User Variables matrix lists the User Variables of the object owning the property view. The name of the variable appears in the left column, and the value appears in the right. Un-initialized values of type Real displays **<empty>** in the right column. Un-initialized non-scalar values displays **<Multidimensional>**.

The User Variables are listed in their execution order. You can change the execution order using the icons in the toolbar.

The toolbar above the matrix lets you create, edit, and delete variables as well as filtering and ordering the list. Until one or more User Variables are added to an object, some of the icons at the top of the property view are disabled. The drop-down list, on the left side of the icons, filters the matrix by data type and customer user type.

**Before you add the first User Variable to an object, only the Create a New User Variable and the Sort Alphabetically and Sort by Execution Order buttons are active.**

The following table lists and describes the icons in the User Variables property view:

| Name  | Icon  | Function  |
|---|---|---|
| <b>Create a New User Variable</b>                     |    | When this icon is clicked, the Create a New User Variable property view opens.  |
| <b>Edit the Selected User Variable</b>                |    | Select an existing User Variable and click this icon to open the property view of the existing User Variable for editing.<br><br>You can also open the edit property view of a User Variable by double-clicking on its name in the matrix.  |
| <b>Delete the Selected User Variable</b>              |    | Select the User Variable you want to delete and click this icon.<br><br>HYSYS requires confirmation before proceeding with the deletion. If a password has been assigned to the User Variable, the password is requested before proceeding with the deletion.                                 |
| <b>Sort Alphabetically</b>                            |  | Click this icon to sort the User Variable list alphabetically.  |
| <b>Sort by Execution Order</b>                        |  | Click this icon to sort the User Variable list according to the order by which they are executed by HYSYS.<br><br>Sorting by execution order is important if your User Variables have order dependencies in their macro code. Normally, you should try and avoid these types of dependencies. |
| <b>Move Selected Variable Up In Execution Order</b>   |  | Click this icon to move the selected User Variable up in execution order.   |
| <b>Move Selected Variable Down In Execution Order</b> |  | Click this icon to move the selected User Variable down in the execution order.   |
| <b>Show/Hide Variable Enabling Checkbox</b>           |  | Displays or hides the Variable Enabling checkboxes associated with each User Variable. By default, the checkboxes are not displayed.  |

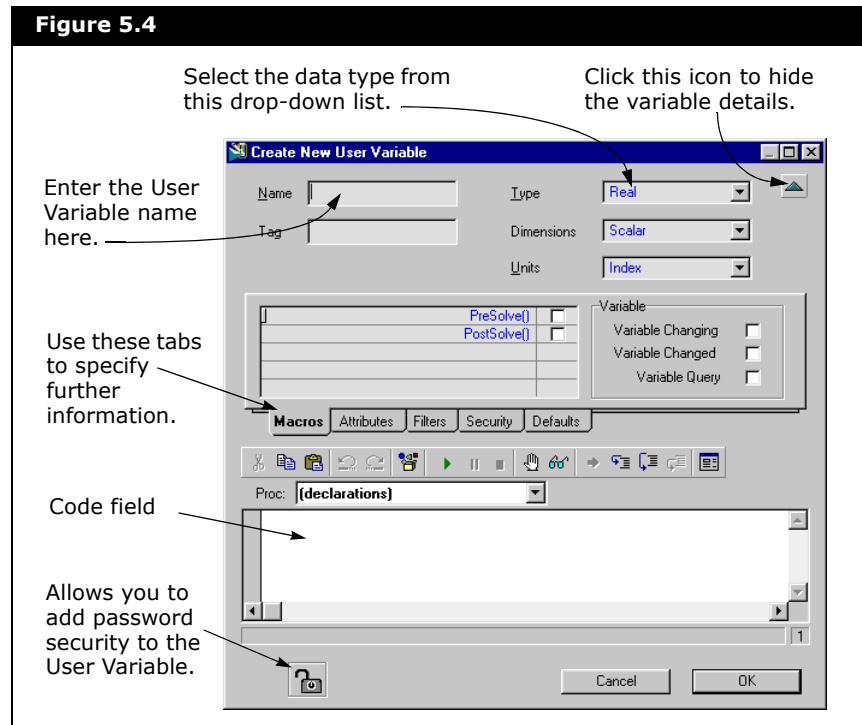


Create a New User Variable icon

To add a User Variable:

1. Access the User Variables matrix in the object where you want to associate the User Variables.
2. In the User Variables property view, click the **Create a New User Variable** icon. The Create New User Variable property view appears.
3. Fill in the parameters for your new User Variable in the Create New User Variables property view. Refer to the figure below for information on how to fill in the User Variable parameters.

**Figure 5.4**

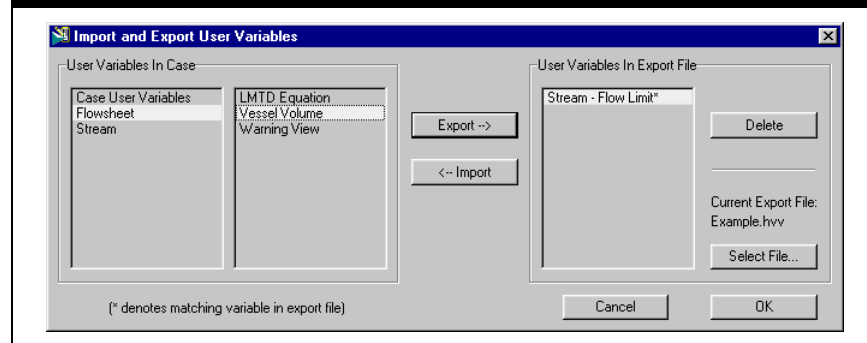


**You can define your own filters on the Filters tab of the User Variable property view.**

## 5.3 Importing/Exporting User Variables

You may import and export User Variables between cases via the Import Export User Variables property view.

**Figure 5.5**

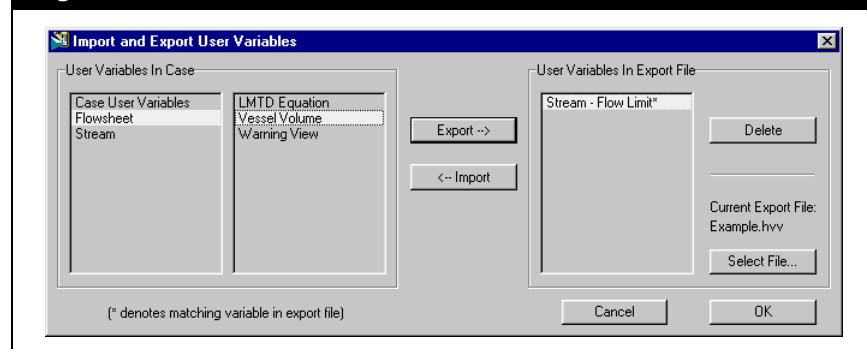


## Exporting a User Variable

The following general procedure can be used to export User Variables:

1. Select **Import and Export User Variables** command from the **Simulation** menu. This opens the Import and Export User Variables property view.

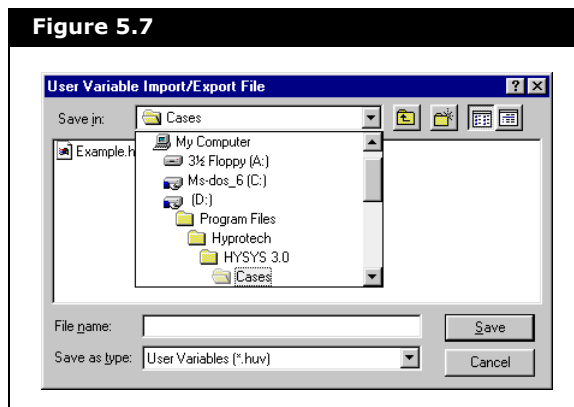
**Figure 5.6**



A list of User Variables currently attached to the case appears in the User Variables In Case group. The list on the right displays a list of variables attached to the object selected in the list on the left.

2. In the User Variables In Case group, select the object containing the User Variable you want to export from the left list, then select the User Variable you want to export from the right list.
3. Click the **Export** button. This opens the User Import/Export Variable File property view.

**Figure 5.7**



4. Select the path you want to save the file in.
5. In the **File name** field type the name of the file you want to save the User Variables to and click the **Save** button.

The file is saved with \*.huv file extension.

## Importing a User Variable

The following general procedure should be used for importing User Variables to a case.

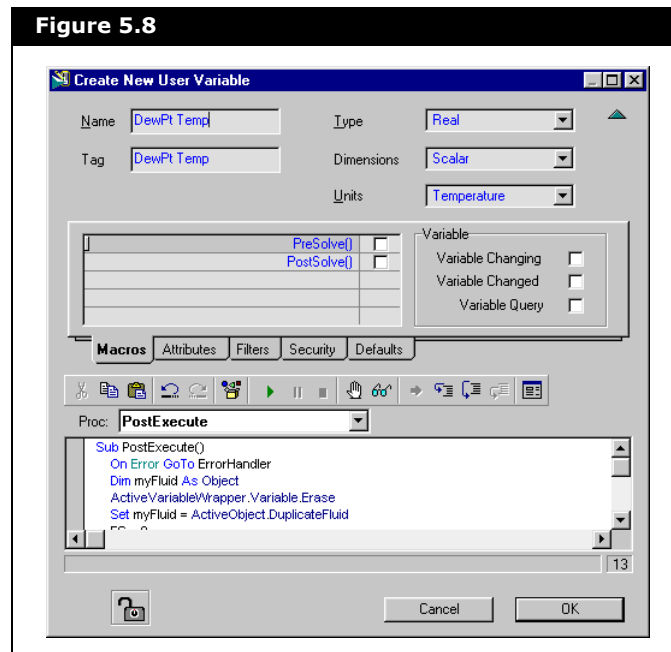
1. Select **Import and Export User Variables** command from the **Simulation** menu. This opens the Import and Export User Variables property view.
2. Click the **Select File** button. This opens the User Variable Import/Export File property view.
3. Find the \*.huv file that contains the User Variables you want to import and click the **Save** button.

The file name you selected should now appear in the User Variables In Export File group under the **Current Export File:** text. A list of user variables in the file should appear in the list in this group.

4. Select the variable you want to import and click the **Import** button.

## 5.4 User Variable Property View

When you add a User Variable to an operation, the Create a New User Variable property view, shown in the figure below, appears.



For more information on using security passwords, see [Section 5.6.4 - Security Tab](#).

The only entry fields common to all user variable data types are the Name and Tag fields. The Name specified is the visible name of the variable used throughout HYSYS. The Tag is the unique identifier used to access this user variable programmatically. These two strings are often identical and the variable tag automatically defaults to be the same as the variable Name, if

not specified. You are prompted to provide an alternate Name or Tag if they are not unique among all User Variables attached to the object. You are also prompted to provide a cryptic tag if the User Variable uses a security password.



Hide Variable Details icon



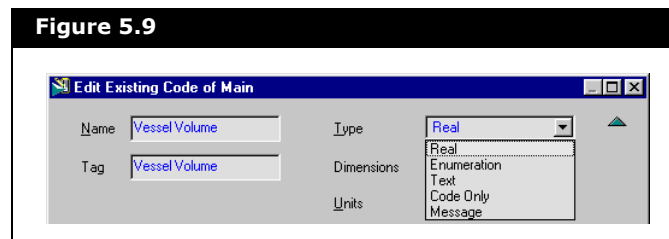
Show Variable Details icon

Finally, the Show or Hide Variable Details icon, in the upper-right corner of the property view, expands or shrinks the Code Editor. This icon either hides or reveals most of the attribute fields of the User Variable. Normally, once a User Variable has been defined, its attributes remain fairly static and most effort is directed toward editing and debugging its macro code. For this reason, the code field is presented in its expanded position when debugging or editing the User Variable, and in its reduced position when creating the variable.

## 5.5 Data Types

### Type Drop-down List

Five data types are available from the Type drop-down list:



- Real (double precision floating point number)
- Enumeration
- Text
- Code Only
- Message

The drop-down list at the top of the User Variables property view can change, depending on the additional requirements for the specified data type.

## Dimensions Drop-down List

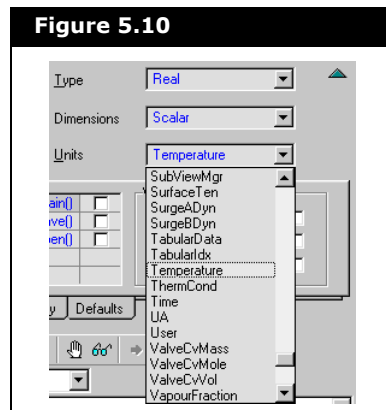
When a Real, Enumeration or Text data type is specified, the Dimensions drop-down list is available on the User Variables property view. Data dimensions available from the drop-down list include:

- Scalar
- Vector (array)
- Matrix
- Cube (3 dimensions)

### 5.5.1 Real Data Type

## Units Drop-down List

The Units drop-down list is available only when Real is selected as the Data Type.



From this drop-down list you can select one of the existing variable types built into HYSYS in order to determine units and valid numeric range for the new variable. For example, selecting Temperature results in a User Variable displaying units of temperature that accepts input in Celsius, Kelvin, Rankin or Fahrenheit. That same variable would also automatically disallow out of range input such as a negative Kelvin value or a Celsius value less than -273.15.



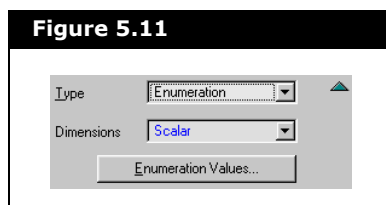
Refer to [Section 5.6.1 - Macros Tab](#) for more details.

This drop-down list defaults to variable type Index, which is a unitless, generic type. The Variable Changing macro can be used to provide custom filtering of input values for a user variable if desired.

## 5.5.2 Enumeration Data Type

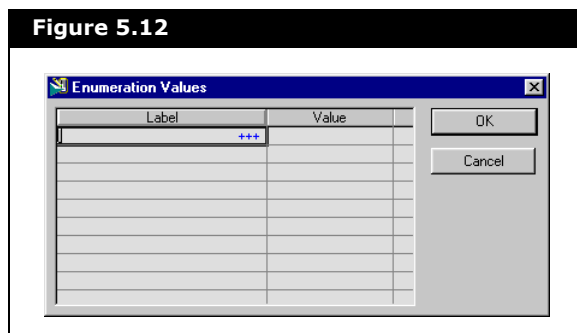
When you select Enumeration as the User Variable type, the Enumeration Values button appears directly below the Dimensions drop-down list:

**Figure 5.11**



Click this button and the Enumeration Values property view, containing a two-column matrix appears:

**Figure 5.12**



Entering text labels in the left column and corresponding numeric values in the right column to define the enumeration. The resulting Enumeration Variable appears in HYSYS property views as a drop-down list containing these text labels. Selecting one of these labels assigns the corresponding value to the User Variable.

## 5.5.3 Message Data Type

Type Message variables have a single purpose: to execute their Fire macro when the user variable is invoked programmatically, usually in response to you clicking a button. Message User Variables are currently applicable mainly to HYSYS Extensions.

## 5.5.4 Code Only Data Type

A user variable of type Code Only allocates no storage space for itself but still serves as a host for attaching macro code. If you want to write macro code that does not preserve any results or state information, then a Code Only User Variable is the most efficient choice.

## 5.6 User Variables Tabs

Additional settings appear in the central pane of the User Variable property view and are grouped under five tabs:

- Macros
- Attributes
- Filters
- Security
- Defaults

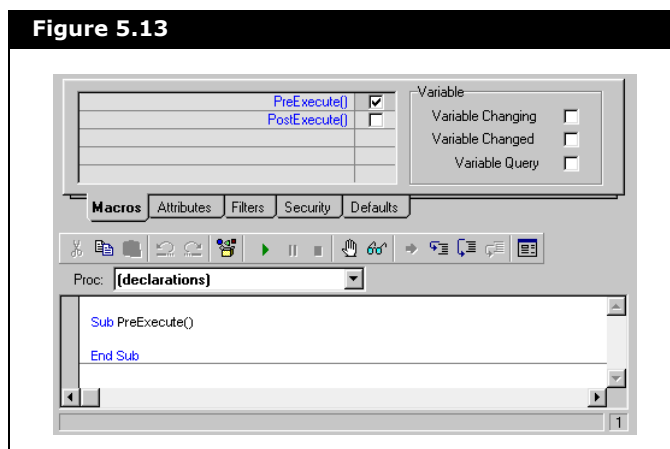
## 5.6.1 Macros Tab

The Macros tab lists the macros that can be enabled for the variable currently being edited. The macros listed on the left side of the tab vary depending on the level within your simulation that the User Variable was created. These macros are described in the following table:

| Object                  | Macros   |
|-------------------------|--|
| <b>Flowsheet Object</b> | <p><b>PreExecuted.</b> Invoked when the Steady State solver is about to execute the flowsheet object that owns this variable.</p> <p><b>PostExecuted.</b> Invoked immediately after the Steady State solver executes the flowsheet object that owns this variable.</p> |
| <b>Flowsheets</b>       | <p><b>PreSolve.</b> Invoked before the Steady State solver begins solving the flowsheet.</p> <p><b>PostSolve.</b> Invoked after the Steady State solver completes the flowsheet solution.</p>  |
| <b>Simulation Case</b>  | <p><b>Run.</b> Explicitly invoked when the <b>Run</b> button on the Simulation Case User Variables property view is clicked.</p>   |

Enable the macro by selecting the checkbox to the right of the macro name, as shown in the figure below. This User Variable is attached to a flowsheet object and, as such, has a Pre-Execute and Post-Execution macro. Once selected, the empty sub-routine code for the macro is initialized in the Code Editor.

**Figure 5.13**



The checkboxes in the Variable group on the right of the **Macros** tab enables macros that are invoked when the value of the User Variable is modified or accessed.

The sub-routines that are added to the User Variable when the checkboxes, in the Variable group, are selected include:

| Sub-routine              | Initialization  |
|--------------------------|---|
| <b>Variable Changing</b> | Called when an attempt is made to specify a new value for the User Variable from any source other than the variable's own macro code. The new value is available for inspection using the <i>ActiveVariableWrapper</i> macro keyword. If the Variable Changing code chooses to disallow the change, it must set the <i>AllowThisChange</i> property to false. |
| <b>Variable Changed</b>  | Invoked immediately after a new value has been assigned to the variable.  |
| <b>Variable Query</b>    | Invoked whenever the value for a User Variable is about to be read.   |

The following code example demonstrates simple bounds checking for a numeric User Variable using a Variable Changing sub-routine:

#### Code Example

```
Sub VariableChanging()
  If ActiveVariableWrapper.NewRealValue > 100 Or
  ActiveVariableWrapper.NewRealValue < 1 Then
    AllowThisChange = False
    MsgBox "Valid values are in the range 1-100", vbOkOnly,
    "User Variable"
  End If
End Sub
```

The presence of code for a particular macro sub-routine is not sufficient to have that code invoked - the macro's checkbox must also be enabled. If you disable a macro, HYSYS requires confirmation before it proceeds with this action. Pasting or typing macro sub-routine code in to the Code Editor causes the specific macro to be automatically enabled.

**If you disable a macro with its code still present and then type or paste in the Code Editor, the macro is automatically re-enabled.**

## 5.6.2 Attributes Tab

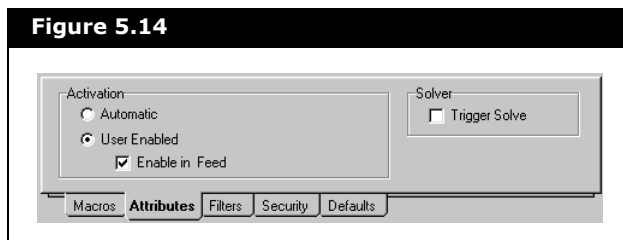
The Attributes tab has two associated groups:

- Activation
- Solver

### Activation Group

The Activation group refers to the scope of the variable. A User Variable is defined for an entire class of objects but can be optionally enabled only in specific instances of these objects or made to appear automatically in all instances. Specify the activation by choosing from either the Automatic or User Enabled radio button. Specify the activation by choosing from either the Automatic or User Enabled radio button.

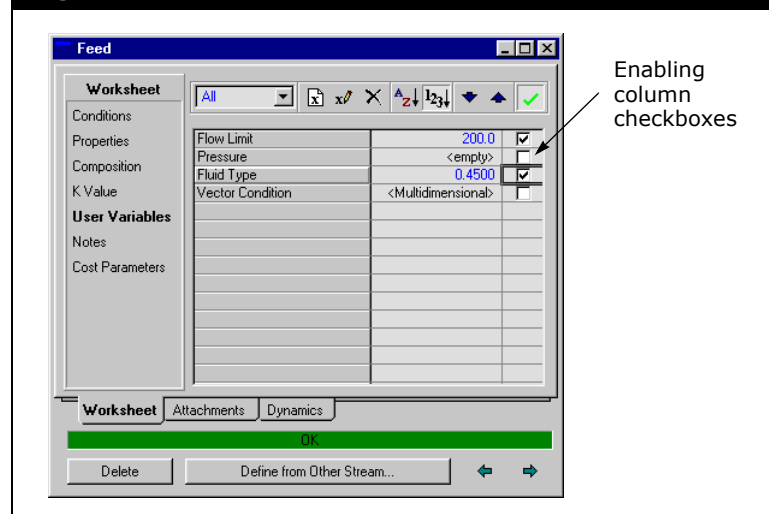
**Figure 5.14**



Automatic User Variables appear in all instances of the object type for which it is defined within a simulation. Most objects have a discrete type such as pumps or mixers. However, some types can manifest themselves in different forms. For example, streams can be either material or energy streams and share their User Variables. That is, variables created in material streams are also available to energy streams, and vice versa. If you do not want a User Variable to be available universally across an object type, you can specify it to be User Enabled setting by selecting the User Enabled radio button.

With the User Enabled radio button selected, specific variables appear only in certain instances of an object type. The variable can be turned *on* or *off* for specific instances of objects of that type. To do this, use the enabling column of the User Variables matrix in the objects' property views.

**Figure 5.15**

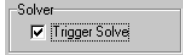


The **Enable In Object Name** checkbox of the Activation group is a short-cut for checking the enable switch of the variable in the current object.

The Automatic setting overrides any previous User Enable settings. HYSYS, however, preserves the user setting and if the variable is switched back to User Enabled, the previously specified setting is restored. This means that you can easily switch specific variables on and off across an entire object type simply by editing the variable from any object instance and changing it between Automatic and User Enabled.

Even if no instances of a particular object type exist in a simulation case, any User Variables previously defined for that object type are preserved. If new instances of the type are ever added to the case, they automatically inherit the previously defined User Variables.

## Solver Group



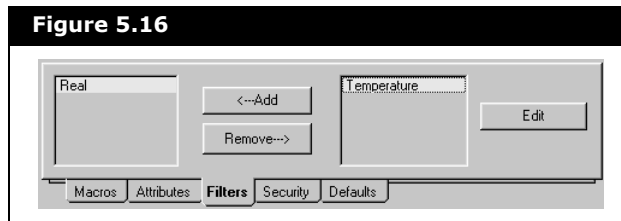
Solver group

The Solver group of the **Attributes** tab contains a single checkbox labelled **Trigger Solve**. This checkbox is only available for Real and Enumeration data types. When enabled, the User Variable causes the object instance that owns it to recalculate whenever the value of the variable is changed. This is analogous to the HYSYS Process Variable.

## 5.6.3 Filters Tab

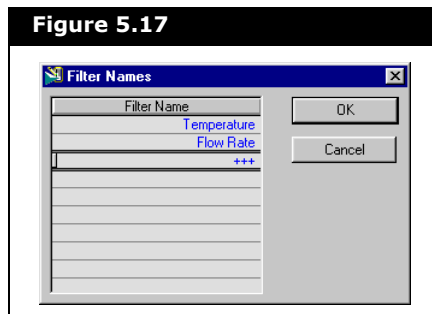
The Filters tab provides a mechanism for creating and assigning custom variable types that can be used to filter User Variables lists.

**Figure 5.16**



To add a new filter type, click the Edit button. The Filter Names property view opens:

**Figure 5.17**



From this property view you can create new filter names. Once the new filter names have been specified, click the OK button to return to the User Variable property view. If you do not want to keep the filter names you specified, click the Cancel button. New filter names appear in the list on the right of the Filters tab.

The native data type (Real, Text, etc.) is always included in the list of active filters. It cannot be deleted. To include a newly created filter name with the active filters, highlight the filter name on the right and click the Add button. To remove a filter from the active list, click the Remove button.

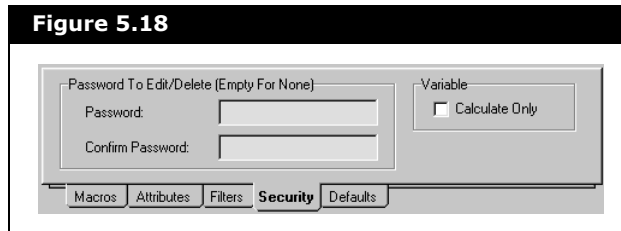
**Filtering can only be applied using the drop-down list of the User Variable page of Unit Operation property views.**

## 5.6.4 Security Tab

There are two levels of User Variable protection available on the Security tab. The two levels are split into two groups on the tab:

- Password to Edit/Delete
- Variable

**Figure 5.18**



### Password to Edit/Delete Group

When you have assigned a password, you are required to enter that password before the variable can be edited or deleted. As a convenience, if the password is entered correctly when requested it is not requested again until the next time the case is opened. However, you are always required to enter the password if you are attempting to delete a User Variable. Combining a password with the Automatic attribute would guarantee that a User Variable is always present in any instance of its owning object.

**A suitably cryptic variable Tag is highly recommended when using a password in order to protect against programmatic access to the variable.**



## Variable

The second level of security is the Calculate Only setting. Select this option to ensure that only the User Variable's macro code can change its value.

### 5.6.5 Defaults Tab

The Defaults tab lets you assign a default value to the User Variable. Default value may only be assigned to scalar variables of type Real, Enumeration, and Text. Without an explicit default value, scalar variables of these types are initially created with empty values.

**Figure 5.19**

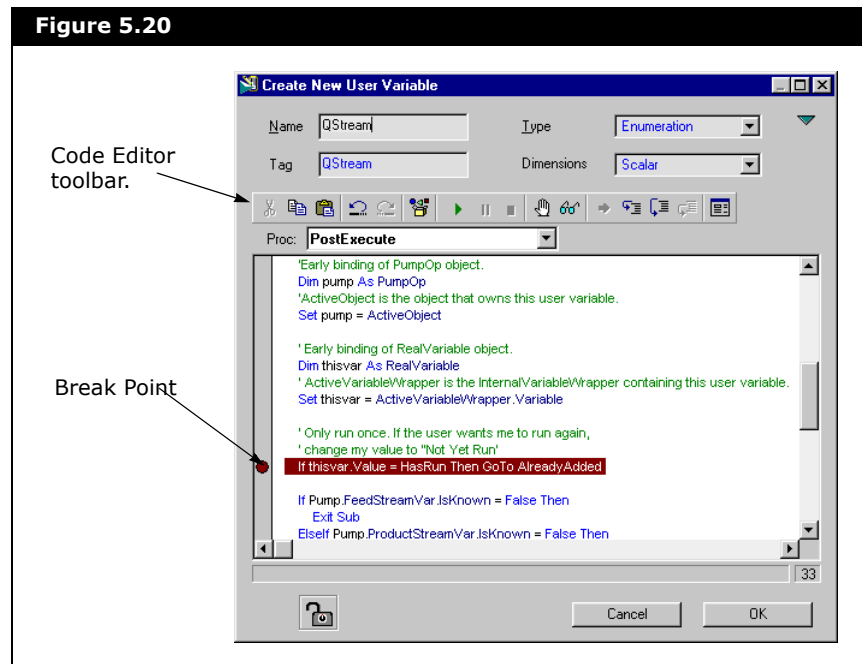
To assign a default value, select the **Assign Default Value** checkbox and enter the desired value in the field.



## 5.7 Code Editor

The Code Editor is where you write, using the Visual Basic<sup>®</sup> compatible macro language, and debug the macro code that you are attaching to a simulation object. You can add break points to the code by simply clicking in the bar that borders the left side of the Code Editor. If there are no break points in your code, the macros execute seamlessly as part of your HYSYS case.

The Code Editor is shown below:



Start Solver icon

**Once changes are made to your code in the Code Editor, click the Start Solver icon to continue with the HYSYS calculations.**

## Tool Tip Text

A single quote (') preceding text in the Code Editor indicates a Visual Basic® user comment. For HYSYS User Variables, any user comments written in the first three lines of the Code Editor appears as a tool tip when the cursor is placed over the User Variable name in the matrix on the User Variable page or tab. See [Figure 5.28](#).

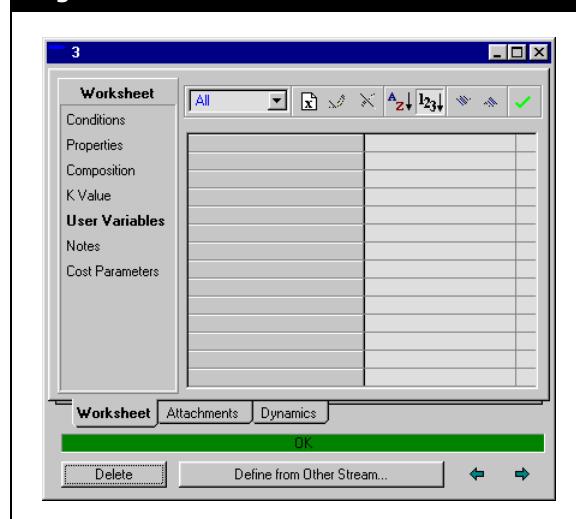
## 5.8 User Variable Examples

### 5.8.1 Dew Point Temperature Variable

The following User Variable example can be applied to any HYSYS simulation. In it, you create a new User Variable that calculates and displays, in the User Variable Matrix, the Dew Point Temperature for a material stream.

1. Open any material stream in your simulation to the User Variables page:

**Figure 5.21**



New User Variable icon

2. Click the **New User Variable** icon at the top of the user variable matrix. The Create New User Variable property view opens.

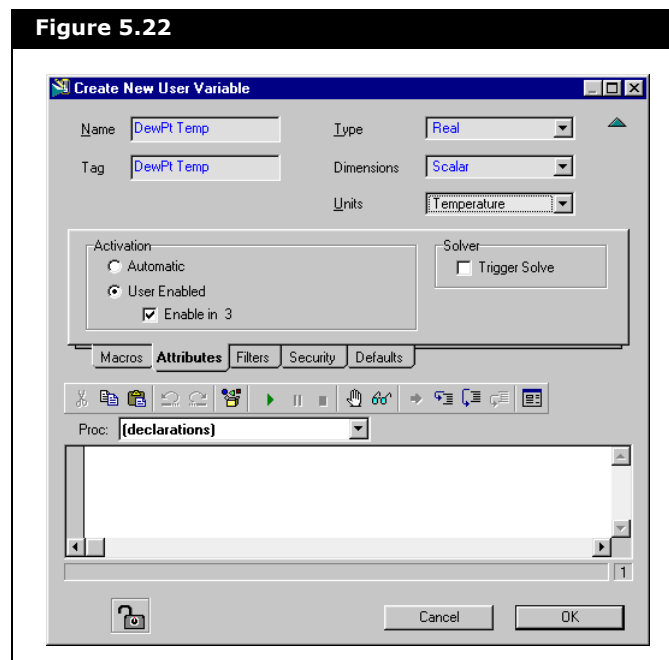
3. In the Create New User Variable property view, enter the following information in the indicated fields:

| Field        | Input       |
|--------------|-------------|
| <b>Name</b>  | DewPt Temp  |
| <b>Type</b>  | Real        |
| <b>Units</b> | Temperature |

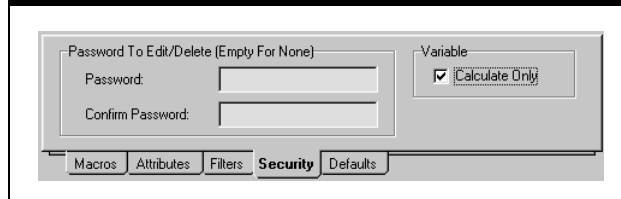
**When you specify a Name, it is automatically copied to the Tag field.**

4. On the **Attributes** tab, select the **User Enabled** radio button in the Activation group. You are then required to manually enable the variable in any of the material streams that requires this variable.

**Figure 5.22**



- On the **Security** tab, select the **Calculate Only** checkbox. This ensures that no one attempts to specify a value for this User Variable other than its macro.

**Figure 5.23**

This step is a convenience and not a requirement for macro execution.

- On the **Macros** tab, select the **PostExecute()** checkbox. An empty sub-routine automatically appears in the Code Editor. Enter the PostExecute macro as follows:

**Macro Code**

```
Sub PostExecute()
    On Error GoTo ErrorHandler
    Dim myFluid As Object
    ActiveVariableWrapper.Variable.Erase
    Set myFluid = ActiveObject.DuplicateFluid
    FS = 0
    FS = myFluid.PVFlash(ActiveObject.PressureValue, 1.0)
    If FS = 0 Then ' fsFlashOK

    ActiveVariableWrapper.Variable.SetValue(myFluid.Temperature.GetValue)
End If
ErrorHandler:
Exit Sub
End Sub
```

The error checking is in place to so that the macro can handle **<empty>** values. If the value is **<empty>** the macro exits the sub-routine and continue on to the next one.

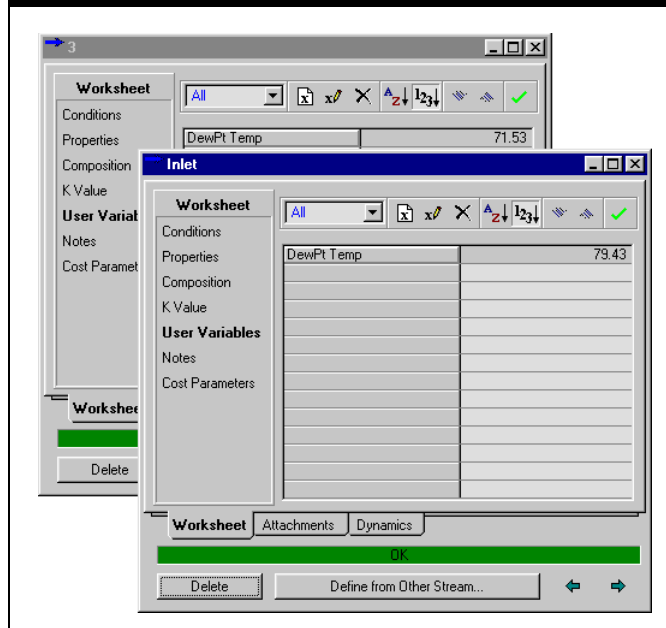
A new User Variable of type Temperature, named DewPt Temp, now exists in all current and future instances of streams in this case. The DewPt Temperature automatically calculates its value during a steady state solve pass immediately after its owning stream executes.

**The user variable exists in both Material and Energy streams, but the dew point calculation only applies to Material streams. The variable fails to calculate a value in energy streams; this is harmless, but the macro could be modified to test for the stream type before performing its calculations.**

Re-calculate the stream and the dew point temperature value appears in the User Variables page for all the streams in your simulation.

The figure below shows two Stream property views with the calculated values:

**Figure 5.24**



## 5.8.2 Automatic Pump Energy Stream

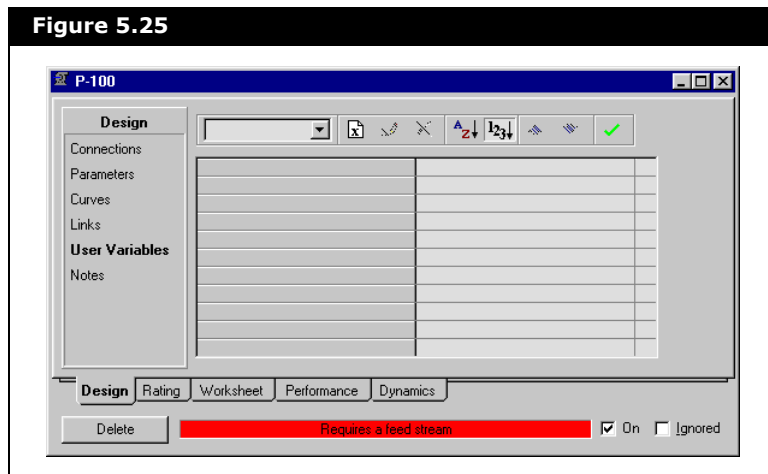
The User Variable created in this example automatically adds an energy stream to a pump operation whenever both Feed and Product streams are connected. This is accomplished through an Enumeration type User Variable. The code is such that the work of creating and connecting the Energy stream to a pump is performed only once, unless otherwise specified. The energy streams added is named using the operation name, followed by "\_W." For instance, the energy stream for pump P-100 is named P-100\_W.

1. Install a pump into the PFD, if the simulation case does not already have a pump. Open the pump property view.
2. Go to the User Variables page on the **Design** tab.
3. Click the **New User Variable** icon from the top of the matrix.



New User Variable icon

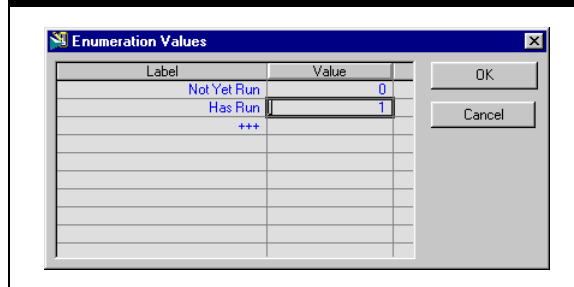
Figure 5.25



4. Enter the following information for the fields in the resulting Create New User Variable property view, as specified in the following table.

| Field | Input       |
|-------|-------------|
| Name  | QStream     |
| Type  | Enumeration |

5. Edit the enumeration values by clicking the **Enumeration Values** button. Create two labels in the left column of this property view named **Not Yet Run** and **Has Run**; assign the values **0** and **1** to them, respectively.

**Figure 5.26**

6. When completed as shown in the figure above, click the **OK** button.

**The Label names are not important, but the numeric values of the two must match the NotYetRun and HasRun constants used in the associated code.**

7. On the **Attributes** tab, select the **Automatic** radio button in the Activation group. This creates the variable in all current and future instances of pumps in your simulation case.



8. Select the **PostExecute()** checkbox found on the **Macro** tab. Enter the following PostExecute macro in the Code Editor.

**Macro Code**

```
' Automatically add and connect an energy stream once feed and product
' streams are connected.
' The process will not repeat unless this variable is reset to NotYetRun.

' Global constants matching the enumeration values of this user variable.
' Note that only constant values are useful here. Non-constant global
' variables will lose their values
' between invocations of this macro code. Create user variables when
' storing persistent 'information.
Const NotYetRun = 0
Const HasRun = 1

' The use of both late and early binding are demonstrated here.
' Late binding should be used during development and testing since it is
' more robust and produces more useful error messages.
' Early binding should be used where performance is an issue as it is
' slightly faster. Or when an explicit 'cast' to a certain interface of
' an object is required.
Sub PostExecute()
' Error handling minimized for clarity.
On Error GoTo UnknownError

'Early binding of PumpOp object.
Dim pump As PumpOp
'ActiveObject is the object that owns this user variable.
Set pump = ActiveObject

' Early binding of RealVariable object.
Dim thisvar As RealVariable
' ActiveVariableWrapper is the InternalVariableWrapper containing this
' user variable.
Set thisvar = ActiveVariableWrapper.Variable
' Only run once. If the user wants me to run again,
' change my value to "Not Yet Run"
If thisvar.Value = HasRun Then GoTo AlreadyAdded
If Pump.FeedStreamVar.IsKnown = False Then
Exit Sub
ElseIf Pump.ProductStreamVar.IsKnown = False Then
Exit Sub
ElseIf Pump.EnergyStreamVar.IsKnown = False Then
```

**Macro Code**

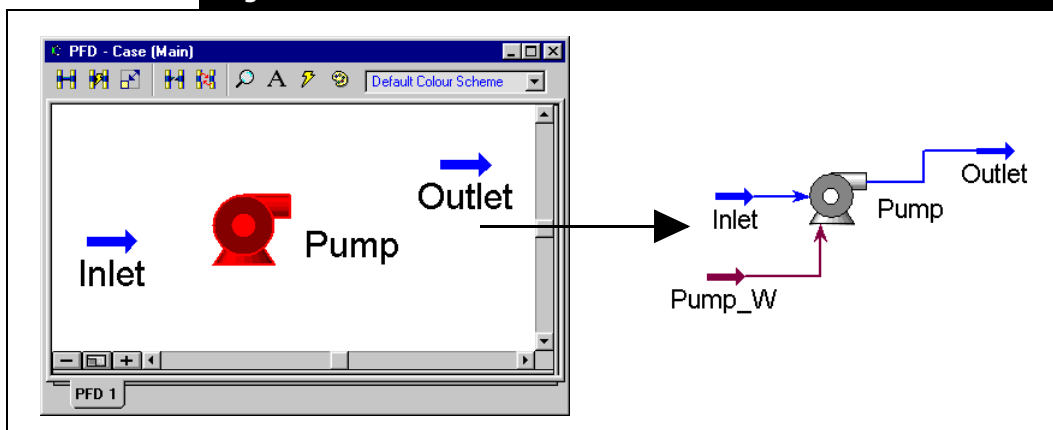
```

'Late binding of Streams collection and Stream object.
Dim str As Object
Dim newstr As Object
Set str = ActiveCase.Flowsheet.MaterialStreams
Dim strName As String
strName = Pump.name + "_W"
Set newstr = str.Add(strName)
newstr.IsEnergyStream = True
Pump.EnergyStream = newstr
thisvar.Value = HasRun
Else
thisvar.Value = HasRun
End If
Exit Sub
AlreadyAdded:
Exit Sub
UnknownError:
End Sub

```

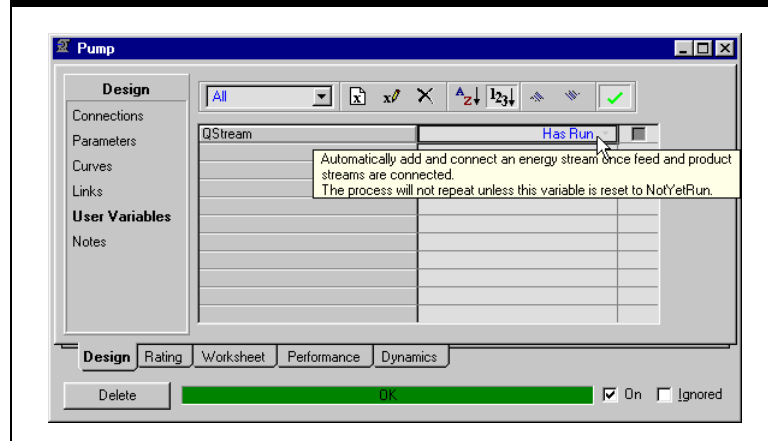
Now, whenever both inlet and outlet streams are connected to any pump in the case, and no energy stream is currently connected to that pump, a new energy stream is automatically created and connected to that pump.

For the pump and streams shown on the left of the figure below, once the inlet and outlet streams are connected, the stream PUMP\_W is automatically created, as shown to the right:

**Figure 5.27**

The first three lines of comment in your code appear as tool tip fly by when the cursor hovers over the variable in on the User Variables page:

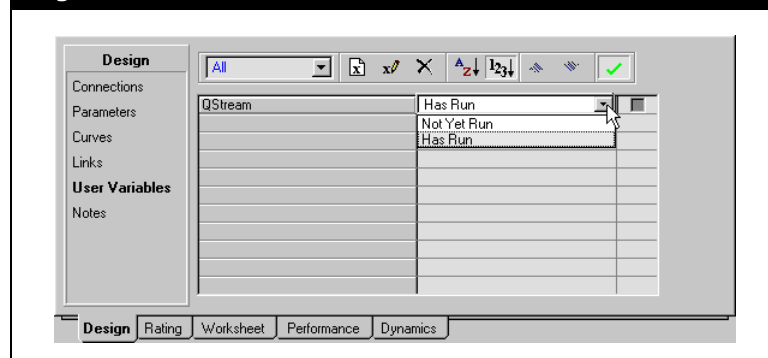
**Figure 5.28**



This process changes the value of the Enumeration User Variable containing the code to Has Run, as shown above. This ensures that the work of creating and connecting the energy stream is not repeated for that pump.

The User Variable enumeration can be explicitly toggled for any pump instance by changing its value in the User Variable Matrix on the User Variables page. Select the value in the right column of the matrix and then access the drop-down list (see the figure below). You can select Not Yet Run from the list.

**Figure 5.29**



**Toggling the setting back to Not Run Yet would allow the macro to once again add and connect a new Energy stream during a steady state execution of the pump when inlet and outlet streams are connected.**



# 6 User Unit Operation

|  |           |
|--|-----------|
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| <b>6.2 Adding a User Unit Operation.....</b> | <b>2</b>  |
| <b>6.3 User Unit Op Property View .....</b>  | <b>5</b>  |
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## 6.1 Introduction

The User Unit Operation is a HYSYS unit operation much like any other, except that its behaviour is defined entirely with Visual Basic® compatible code that you provide. It allows you to create additional unit operation types without the complexity involved in creating an Extension Unit Operation.

With properly designed code, a user-defined unit operation type can be seamlessly integrated in to HYSYS cases and for use by third parties. However, this level of sophistication and user-friendliness is not necessary for all user ops - you may want to quickly create a type that is specialized for use in specific situations or at a specific location in a case.

## 6.2 Adding a User Unit Operation

Adding a User Unit Operation to a case requires you to follow a slightly different procedure than is normally followed when adding the standard HYSYS unit operations. Before you can add the initial User Unit Operation to a case, you must first create an operation Type. The Type is simply a classification for the User Unit Operation, much like Pumps or Heaters are types for unit operations that currently exist in HYSYS.

To add a User Unit Operation:

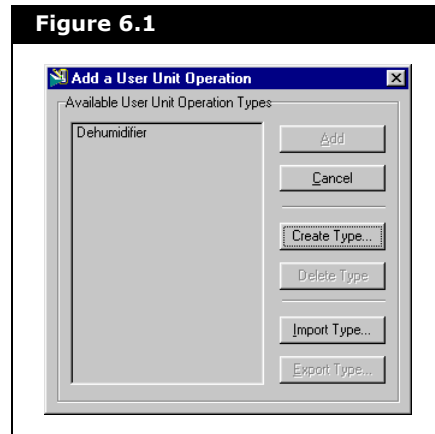
1. Do one of the following:
  - Open the Object Palette (press **F4**) and double-click the **User Ops** icon from the Object Palette.
  - Select **Add Operation** command from the **Flowsheet** menu, or press **F12**. The UnitOps property view appears. Select **User Unit Ops** from the Available Unit Operations group on the UnitOps property view.



User Ops icon

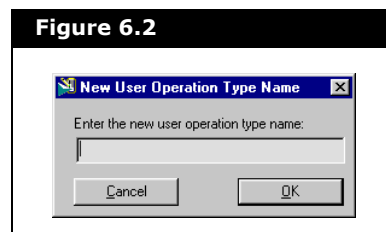
**If you use the User Ops filter on the UnitOps property view, the left side of the property view changes to include the same buttons that appear in the property view on [Figure 6.1](#).**

2. When the User Unit Operation has been added, the following property view appears:



The property view shown above lists the available User Unit Operation types, lets you add new operations of existing types, and lets you create or delete operation types.

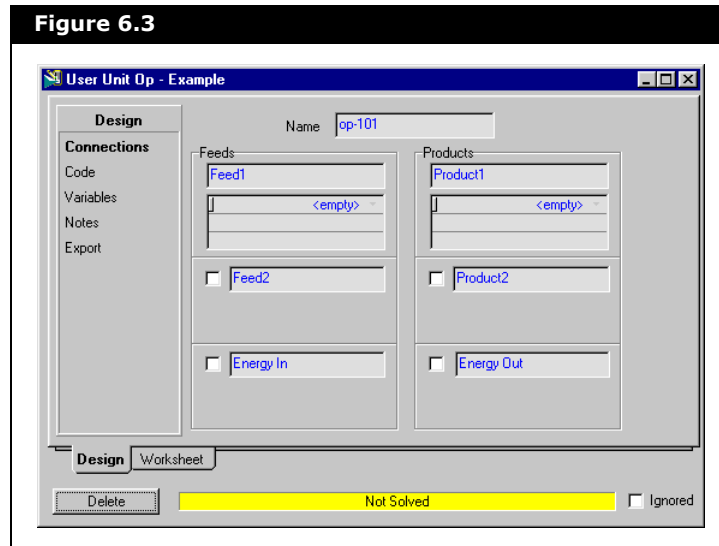
3. Click the **Create Type** button to add a new type to the list. The following property view opens:



4. Enter a descriptive name for the operation type you want to create and click the **OK** button. This type is added to the Available User Unit Operation Types group in the Add a User Unit Operations property view.



- To add an operation of that type, highlight the type you created and click the **Add** button. The User Unit Op property view appears:



**By default, the second feed and product nozzles, as well as the energy nozzles are checked.**

## Importing and Exporting a User Unit Op

The Add a User Unit Operation property view contains two buttons: Import and Export that allow you to transfer User Unit Operations between cases.

### Exporting a User Unit Op

- To export a User Unit Op, simply select the User Unit Op type you want to export and click the **Export** button.
- The Export User Unit Op property view appears. Type the name of the file you want to save under in the File name field.
- Choose the path you want to save the file to.

4. Click the **Save** button.
5. The file is saved with \*.huo file extension.

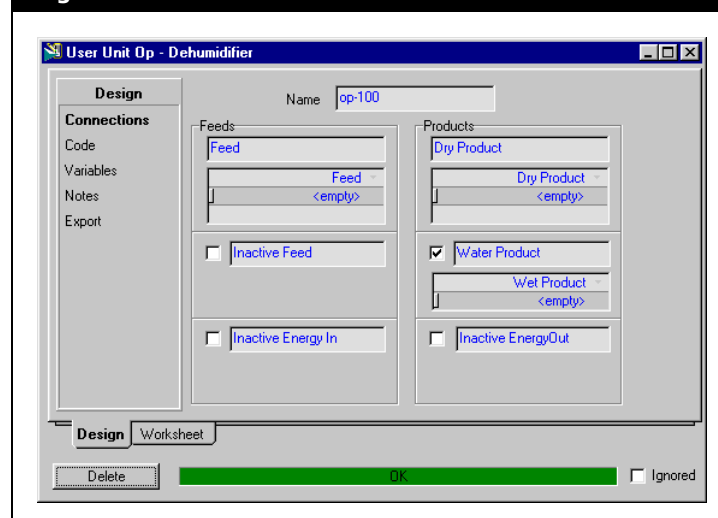
## Importing a User Unit Op

1. Click the **Import** button on the Add a User Unit Op property view.
2. From the Import User Unit Op property view, select the \*.huo file that contains the User Unit Op type you want to import.
3. Click the **Open** button. This should add the User Unit Op to the list of Available User Unit Operation Types.

## 6.3 User Unit Op Property View

Unlike most other HYSYS unit operations, the User Unit Op property view consists of only two tabs: Design and Worksheet.

**Figure 6.4**



**By default, the second feed and product nozzles, as well as the energy nozzles are checked.**

## 6.3.1 Design Tab

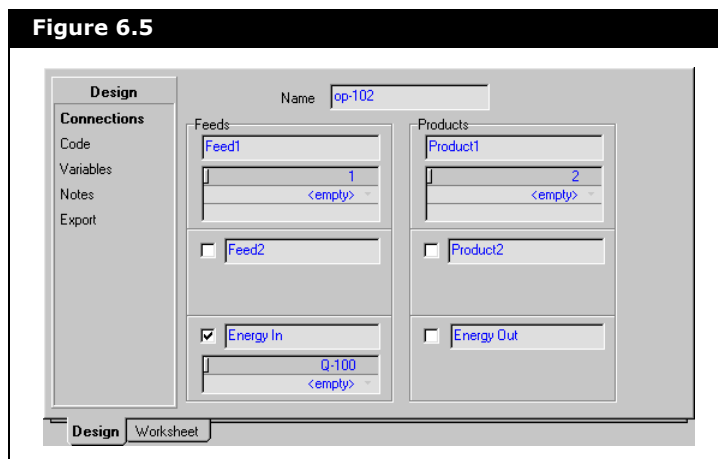
There are five pages associated with the Design tab:

- Connections
- Code
- Variables
- Notes
- Export

### Connections Page

On the Connections page you can specify the Name of the operation, and attach Feed, Product, and Energy streams.

**Figure 6.5**



You can add as many Feed and Product streams as your operation requires. Each User Unit Operation has two material feed nozzles, two material product nozzles, one energy feed nozzle, and one energy product nozzle available. Each of these nozzles can accept multiple stream attachments. HYSYS provides default nozzle names - Feed1, Product1, etc. These names can be changed to better describe the functioning of your operation.

The first feed and first product nozzles are always active, but the other four nozzles can be activated or deactivated depending on the type of requirements of your User Unit Operation. Attach streams to the nozzles in the matrices directly below the nozzle names. Highlight the <empty> cell and select an available stream name from the drop-down list, or enter the stream name directly. To change the name of the nozzle, simply click on the appropriate field and begin typing.

If you want a second nozzle for feed or product streams, select the checkbox directly to the right of the second stream nozzle field (Feed2 or Product2). The **Connections** page changes and activates another matrix. This matrix allows you to attach the streams to a second stream nozzle.

If your User Unit Operation requires Energy streams, select the checkboxes to the right of the Energy In or Energy Out fields and once again, a stream matrix becomes visible.

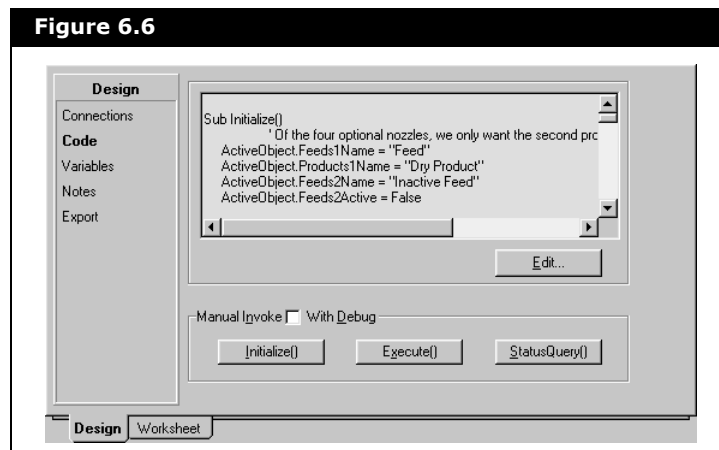
Nozzles can also be configured programmatically. This is the preferred mechanism when designing a User Unit Operation that may be added multiple times to a flowsheet or different cases.

Refer to the code in **Section 6.4 - Dehumidifier Example** for an example of automatically configuring nozzles in the Initialize sub-routine.

## Code Page

On the Code page, you add the Visual Basic® compatible code that defines the behaviour of your User Unit Operation.

**Figure 6.6**

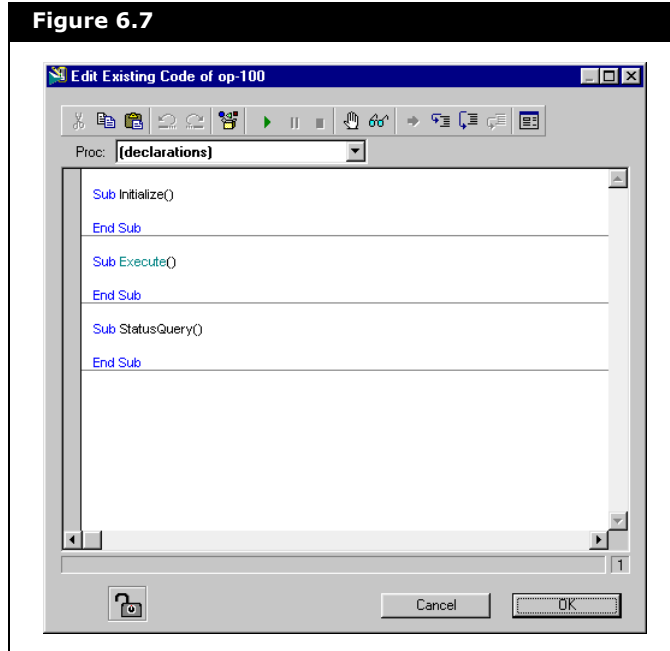


Refer to **Chapter 5 - User Variables** for more information.

The code environment in the User Unit Operation is very similar to that described for the User Variables.

Code can be added by clicking the Edit button. This opens the Edit Existing Code property view. The property view in the figure below shows the three empty sub-routines that appear before you begin adding code in the property view.

**Figure 6.7**



The three User Unit Operation sub-routines are described in the following table:

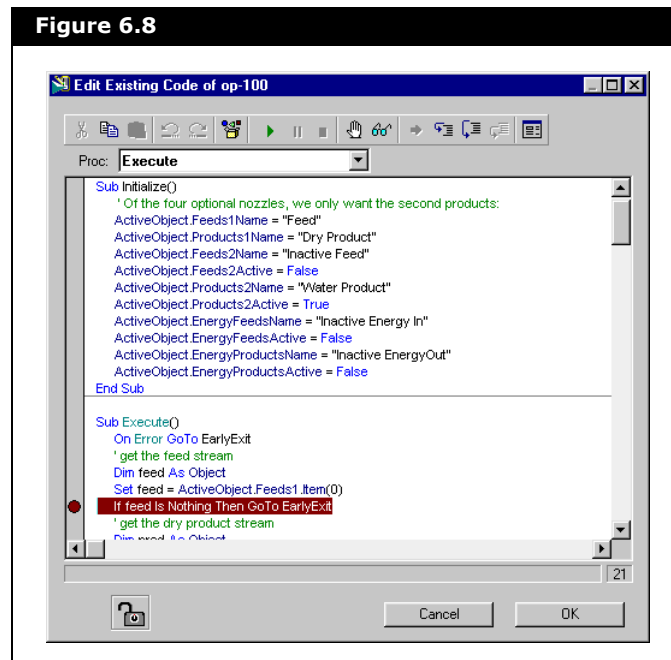
| Sub-routine          | Action  |
|----------------------|---|
| <b>Initialize()</b>  | Called immediately before the first time <b>Execute</b> is called. This sub-routine should be used to set up the unit operation. Decide which nozzles are valid and name them; create any variables that will be needed and give them initial values, etc.  |
| <b>Execute()</b>     | Called whenever a trigger solve variable of the unit operation is changed, and whenever any of its attached streams re-calculates. This sub-routine should perform all of the unit operation's calculations. In this sub-routine only, it is permissible (and recommended) to use the <b>Calculate</b> method to write data to variables of the operations attached streams. These variables are then displayed in black in HYSYS, and cause an inconsistency error if any other object attempts to calculate their values. |
| <b>StatusQuery()</b> | Called whenever HYSYS wants to update the status information for its objects. This sub-routine should be used to provide warning and error messages for any missing connections, missing variable values, etc. These messages will be displayed in the HYSYS status bar, as well as at the bottom of the <b>User Unit Operation's</b> property view.  |

Empty versions of these three sub-routines are automatically generated for each new User Unit Operation Type.

**It is recommended that any sub-routine that you do not want to be implemented be deleted or turned in to comments by preceding each line with the single-quote comment character. This ensures that HYSYS does not waste time calling an empty sub-routine. The sub-routine can be implemented or un-commented at any time.**

The left border of the Code page is a development tool for you to use as you add code to your operation. You may add break points in this border thereby allowing you to step through your code. Simply click the primary mouse button in the margin on the left side of the code pane next to the line you want to insert the break for.

The standard debugging property view is shown as follows:



## Variables Page

You can attach User Variables to the User Unit Operation, as you can to any flowsheet object, to further customize your simulation case.

**User Variables do not have the PreExecute and PostExecute macro options.**

**The Execute macro of the User Unit Operation itself is intended to perform all calculations required to implement the operation and its variable values.**

For more information on adding code and implementing this option, see [Chapter 5 - User Variables](#).

User Unit Operation User Variables can be used to store calculation results, persistent state information, etc. These variables can be created manually from the Variables page, or programmatically using the CreateUserVariable method of the Active Object interface.

## Notes Page

The Notes page provides a text editor where you can record any comments or information regarding the User Unit Operation, or pertaining to your simulation in general.

## Export Page

The Export page allows you to export the User Unit Operation, by clicking the Export button and entering the file name and file path for the User Unit Operation. The file is saved with \*.huo file extension.

You can also add a description about the User Unit Operation in the Type Description group.

## 6.3.2 Worksheet Tab

The Worksheet tab provides the same information as the default Material Streams page of the Workbook. However, this page only displays the streams that are currently attached to the User Unit Operation.



## 6.4 Dehumidifier Example

The following example shows how to create a new User Unit Operation. This operation will function as a dehumidifier. From a single feed stream containing water, the operation copies the conditions and composition of its feed stream in to two product streams. The first product consists of the stream composition minus any water; the second is a pure water stream.



New Case icon

1. Begin by creating a new case. Click the **New Case** icon.
2. Create the following fluid package and then enter the Main Simulation Environment:

| Property Package | Components  |
|------------------|---|
| <b>PRSV</b>      | Methane, Ethane, Propane, i-Butane, n-Butane, i-Pentane, H <sub>2</sub> O |

3. Specify a material stream **Feed**, with the following properties:

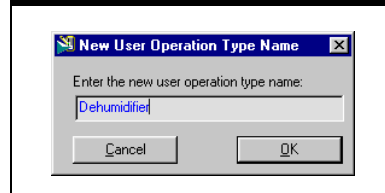
| Stream Properties                      | Value    |
|--|----------|
| <b>Temperature [C]</b>                 | 23.0000  |
| <b>Pressure [kPa]</b>                  | 303.9750 |
| <b>Molar Flow [kgmole/h]</b>           | 100.0000 |
| <b>Comp Mole Frac [Methane]</b>        | 0.40     |
| <b>Comp Mole Frac [Ethane]</b>         | 0.20     |
| <b>Comp Mole Frac [Propane]</b>        | 0.15     |
| <b>Comp Mole Frac [i-Butane]</b>       | 0.10     |
| <b>Comp Mole Frac [n-Butane]</b>       | 0.05     |
| <b>Comp Mole Frac [i-Pentane]</b>      | 0.05     |
| <b>Comp Mole Frac [H<sub>2</sub>O]</b> | 0.05     |

4. Add two more material streams: Dry Product and Wet Product.
5. Add a new User Unit Operation to your case. Double-click the **User Ops** icon from the Object Palette. The Add a User Unit Operation property view appears.



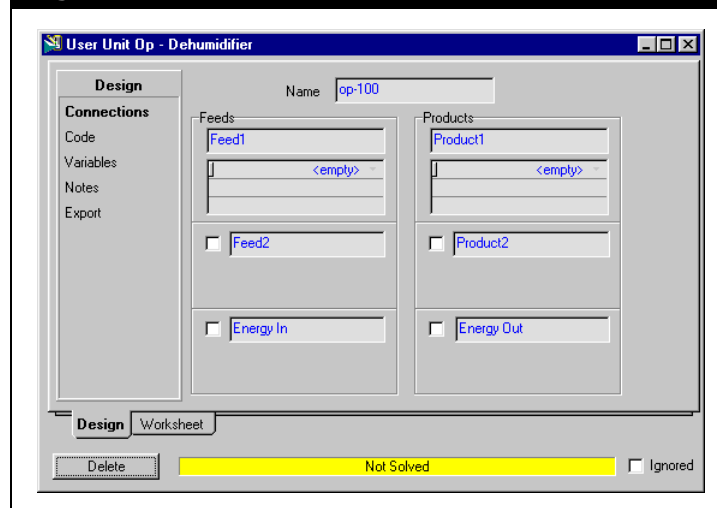
User Ops icon

- Click the **Create Type** button on the Add a User Unit Operation property view. Enter **Dehumidifier** as the New User Operation Type name field and click the **OK** button.

**Figure 6.9**

The Dehumidifier operation type is added to the list of User Ops types for the current case.

- After you click the **OK** button, both New User Operation Type Name and Add a User Unit Operation property views close, and User Unit Op property view for the dehumidifier appears as shown in the figure below.

**Figure 6.10**

This operation requires that a single feed nozzle and both product nozzles are active. As no energy stream is required for the operation, the energy nozzles can be left inactive.

At this point, the op-100 is unable to perform any calculations on any attached streams.

8. To add code, switch to the **Code** page and click the **Edit** button. This opens the Edit Existing Code property view where you can enter the following code:

#### Dehumidifier Code

```

Sub Initialize()
    ' Of the four optional nozzles, we only want the second products:
    ActiveObject.Feeds1Name = "Feed"
    ActiveObject.Products1Name = "Dry Product"
    ActiveObject.Feeds2Name = "Inactive Feed"
    ActiveObject.Feeds2Active = False
    ActiveObject.Products2Name = "Water Product"
    ActiveObject.Products2Active = True
    ActiveObject.EnergyFeedsName = "Inactive Energy In"
    ActiveObject.EnergyFeedsActive = False
    ActiveObject.EnergyProductsName = "Inactive EnergyOut"
    ActiveObject.EnergyProductsActive = False
End Sub

Sub Execute()
    On Error GoTo EarlyExit
    ' get the feed stream
    Dim feed As Object
    Set feed = ActiveObject.Feeds1.Item(0)
    If feed Is Nothing Then GoTo EarlyExit
    ' get the dry product stream
    Dim prod As Object
    Set prod = ActiveObject.Products1.Item(0)
    If prod Is Nothing Then GoTo EarlyExit
    ' get the water product stream
    Dim wtr As Object
    Set wtr = ActiveObject.Products2.Item(0)
    If wtr Is Nothing Then GoTo EarlyExit
    ' find the position of water in the current Fluid Package's component
list
    Dim theComps As Object
    Set theComps = ActiveObject.Flowsheet.FluidPackage.Components
    waterPosn = theComps.index("H2O")
    ' get the array of component molar flows from the feed stream
    Dim CMFs As Variant
    CMFs = feed.ComponentMolarFlowValue
    WaterFlow = CMFs(waterPosn)
    DryFlow = Feed.MolarFlowValue - WaterFlow
    ' calculate the Temperature, Pressure, and Flow of the water product

```

**Dehumidifier Code**

```

stream
    wtr.Pressure.Calculate(feed.PressureValue)
    wtr.Temperature.Calculate(feed.TemperatureValue)
    wtr.MolarFlow.Calculate(WaterFlow)
    ' remove the water from the CMF array
    CMFs(waterPosn) = 0.0
    ' calculate Temperature, Pressure, and ComponentMolarFlows of the dry
stream
    prod.Pressure.Calculate(feed.PressureValue)
    prod.Temperature.Calculate(feed.TemperatureValue)
    prod.MolarFlow.Calculate(DryFlow)
    ' calculate the composition of the dry stream
    For i = 0 To theComps.Count - 1
        CMFs(i) = CMFs(i) / DryFlow
    Next i
    prod.ComponentMolarFraction.Calculate(CMFs)
    ' calculate the composition of the water stream (pure water)
    For i = 0 To theComps.Count - 1
        CMFs(i) = 0.0
    Next i
    CMFs(waterPosn) = 1.0
    wtr.ComponentMolarFraction.Calculate(CMFs)
    ' tell the Solver we're done
    ' (this will remove the "Not Solved" status message)
    ActiveObject.SolveComplete
    Exit Sub
EarlyExit:
    ' not enough info to calculate
End Sub
Sub StatusQuery()
    On Error GoTo That'sAll
    Dim GotOne As Boolean
    GotOne = False
    If ActiveObject.Feeds1.Count = 0 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slMissingRequiredInformation, 1,
"Feed Stream Required")
    End If
    If ActiveObject.Products1.Count = 0 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slMissingRequiredInformation, 2,
"Dry    Product Stream Required")
    End If

```

**Dehumidifier Code**

```

    If ActiveObject.Products2.Count = 0 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slMissingRequiredInformation, 3,
"Water Product Stream Required")
    End If
    ' If we're missing an attachment, don't bother checking for any other
problems
    If GotOne = True Then GoTo ThatsAll
    On Error GoTo NoWater
    waterPosn =
ActiveObject.Flowsheet.FluidPackage.Components.index("H2O")
    GoTo AfterWaterCheck
NoWater:
    GotOne = True
    ActiveObject.AddStatusCondition(slError, 11, "No Water in Current Fluid
Package")
AfterWaterCheck:
    On Error GoTo ThatsAll
    Dim feed As Object
    Set feed = ActiveObject.Feeds1.Item(0)
    If Not feed.Temperature.IsKnownThen
        ActiveObject.AddStatusCondition(slMissingOptionalInformation, 12,
"Feed Temperature Unknown")
        GotOne = True
    End If
    If Not feed.Pressure.IsKnownThen
        ActiveObject.AddStatusCondition(slMissingOptionalInformation, 13,
"Feed Pressure Unknown")
        GotOne = True
    End If
    If Not feed.MolarFlow.IsKnown Then
        ActiveObject.AddStatusCondition(slMissingOptionalInformation, 14,
"Feed Flow Unknown")
        GotOne = True
    End If
    ' The composition's IsKnown will return a Variant containing an array of
Booleans.
    ' We must make a variable containing the array before we attempt to
access a data
    ' member.
    ' (i.e., "feed.ComponentMolarFraction.IsKnown(0)" will probably not
work)
    CMFsKnown = feed.ComponentMolarFraction.IsKnown

```

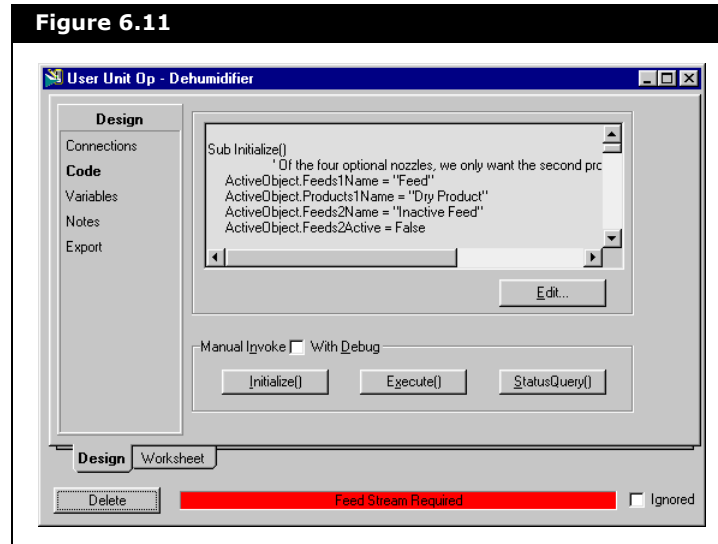
**Dehumidifier Code**

```
    If Not CMFsKnown(0) Then
        ActiveObject.AddStatusCondition(slMissingOptionalInformation, 15,
"Feed Composition Unknown")
        GotOne = True
    End If
    If GotOne = True Then GoTo ThatsAll
    If ActiveObject.Feeds1.Count > 1 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slWarning, 20, "Additional Feed
Stream(s) Ignored")
    End If
    If ActiveObject.Feeds1.Count > 1 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slWarning, 20, "Additional Feed
Stream(s) Ignored")
    End If
    If ActiveObject.Products1.Count > 1 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slWarning, 21, "Additional Dry
Product Stream(s) Ignored")
    End If
    If ActiveObject.Products2.Count > 1 Then
        GotOne = True
        ActiveObject.AddStatusCondition(slWarning, 22, "Additional Water
Product Stream(s) Ignored")
    End If
    Dim BogusCnxn As Boolean
    BogusCnxn = False
    If ActiveObject.Feeds2.Count > 0 Then
        BogusCnxn = True
    ElseIf ActiveObject.EnergyFeeds.Count > 0 Then
        BogusCnxn = True
    ElseIf ActiveObject.EnergyProducts.Count > 0 Then
        BogusCnxn = True
    End If
    If BogusCnxn = True Then
        GotOne = True
        ActiveObject.AddStatusCondition(slWarning, 7, "Connection(s) to
Inactive Nozzles")
    End If
ThatsAll:
End Sub
```

When this code has been inserted, the Dehumidifier operation is complete. Any additional Dehumidifier objects added to the case will automatically access the same code, and function identically to the one already created.

9. Click the **OK** button to close the Edit Existing Code property view and return to the **Code** page of the User Unit Op property view.

**Figure 6.11**



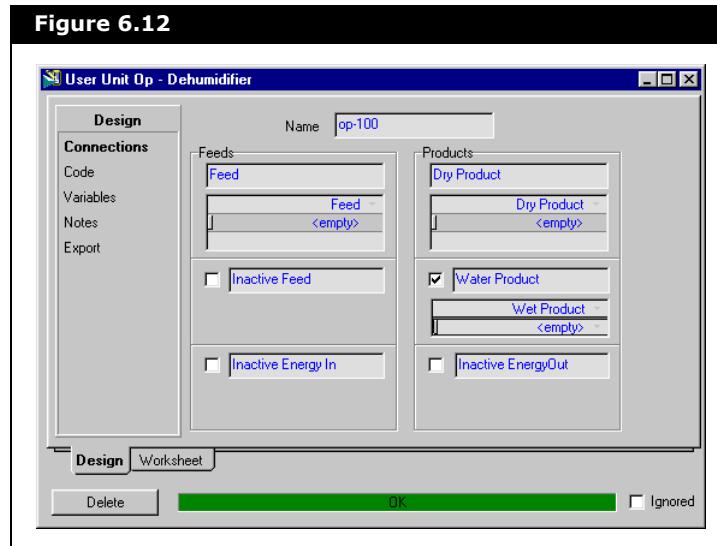
The Initialize sub-routine code automatically configures the nozzles appropriately.

The original instance of the Dehumidifier may invoke Initialize before you have entered the example code.

10. Click the **Initialize** button in the Manual Invoke group to ensure that the nozzles are reconfigured.

Any future instances of Dehumidifier will not require this explicitly extra Initialize once the macro code has been entered and debugged.

11. Complete the **Connections** page by attaching streams as shown in the figure below:



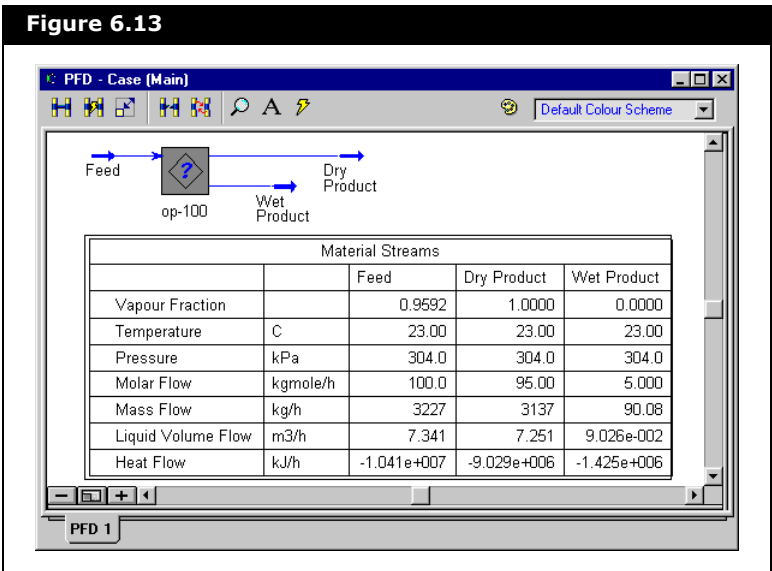
Deactivate the extra nozzles by clearing the checkboxes to the right of the nozzle names.

When a stream is connected to the first nozzle attachment, the Initialize sub-routine should run. The Execute and StatusQuery sub-routines should also run, because the attachments are fully defined.

If streams had not already been attached to the nozzles on the Connections page, the StatusQuery would have prompted you to provide sufficient attachments and information for the Execute to run successfully.



The PFD for the solved case, along with an attached stream table, is shown in the figure below:



# 7 Aspen Custom Modeler Operation

|   |           |
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## 7.1 Introduction

Aspen Custom Modeler (ACM) is a component of the Aspen Engineering Suite designed to suit the need of the fast-paced process modeling industry. ACM allows you to create custom process models that encapsulate specific expertise and proprietary knowledge by using high-level process modeling language. You can use this language to describe the unique properties of a unit operation or stream, and list equations as they are found in chemical engineering textbooks or literature.

ACM models can be exported and used in other AspenTech simulation tools (i.e., Aspen Plus, Aspen Dynamics, and HYSYS). The versatile compatibility of ACM models not only leverages the dependence on one particular simulator, but also combines the strengths of those compatible simulators to provide maximum customized modeling.

In HYSYS, ACM models can be imported and configured as a user operation. You can manipulate the modeling parameters of the ACM model in HYSYS the same way the model is built in ACM.

Refer to the **Software License Manager (SLM) Installation and Reference Guide** for more information on licenses.

**To run an exported ACM model in HYSYS, you must have a valid AEA\_ACM\_Export\_Model license.**

**If you have Aspen Custom Modeler (ACM) or Aspen Dynamics (AD) installed and you export a model from either of those applications, then the model can be used in HYSYS and Aspen Plus without the required additional license. HYSYS will use one ACM or AD license for this capability. By default, HYSYS will first check for a valid ACM model export license (which does not require ACM or AD to be installed). If this license cannot be found, it will use an ACM or AD application license depending on the source of the exported model. If the required ACM or AD license still cannot be located, then ACM will not solve. You will only be able to open the case and work with the rest of the simulation.**

## 7.2 Creating an ACM Model

The functionality of the ACM Op is defined by the Aspen Property file and ACM exported model. The ACM Op will not solve without either one of them. The following sections describe the steps to create and export a simple ACM model, and generate a property file using Aspen Plus.

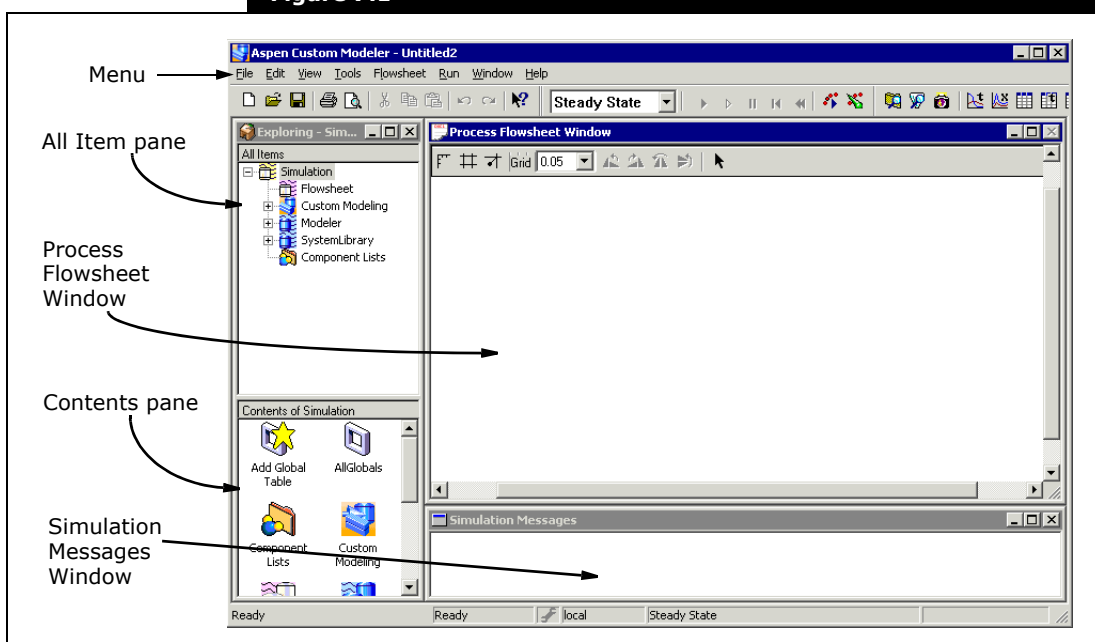
### 7.2.1 Creating & Exporting an ACM Model

To create and export an ACM model:

1. Start **Aspen Custom Modeler**.

The following property view appears.

**Figure 7.1**





Add Model

Add Model icon


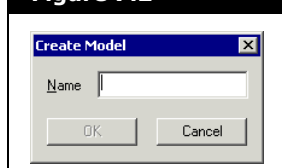
2. Open **MyPipe.acmf** from the ModelExport folder in the Examples folder.  
The supplied "MyPipe" ACM example can be exported and used in HYSYS as discussed in the ACM online help.
3. In the All Item pane, expand the **Custom Modeling** branch by clicking the **Expansion** icon .
4. Select the **Models** sub-branch.
5. In the Contents of Models pane, double-click on the **Add Model** icon. The Create Model dialog box appears.

Figure 7.2



6. Enter **StreamMultiplier** in the Name field.
7. Click **OK**. The Text Editor automatically opens. Type the following code for the StreamMultiplier model.

Figure 7.3

```

Model StreamMultiplier

//Can also use MaterialPort which adds molar volume

Inlet1 as input MainPort;
Outlet1 as output MainPort;

FlowRatio as Constant;
FlowRatio: 1.0, Fixed;

PressureEqn:   Outlet1.P = Inlet1.P;
TemperatureEqn: Outlet1.T = Inlet1.T;
EnthalpyEqn:   Outlet1.H = Inlet1.H;
CompEqn:       Outlet1.z(componentlist) = Inlet1.z(componentlist);

FlowEqn:       Outlet1.F = FlowRatio * Inlet1.F;

end

```

8. Close the Text Editor. The Text Editor automatically prompts you to save the code. Click **Yes** to save the code. A new model icon named **StreamMultiplier** is created in the Contents of Models pane.

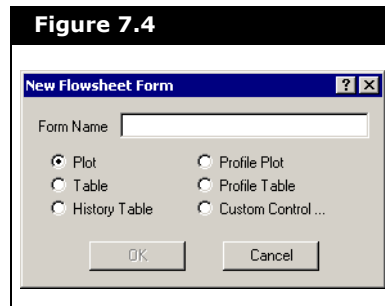


Add Form

Add Form icon

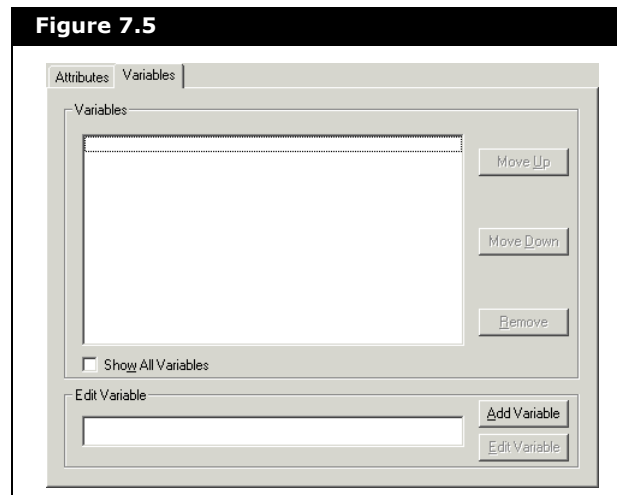
9. In the Contents of Models pane, right-click on the **StreamMultiplier** model icon, and select **Compile** from the object menu (or press **F8**) to compile the code for the model.
10. Double-click on the **StreamMultiplier** model icon. The Contents pane displays the options available for the StreamMultiplier model.
11. In the Contents of StreamMultiplier pane, double-click on the **AddForm** icon to open the Add Form Instance property view.

Figure 7.4



12. Enter **Ratio** in the Name field, and select **Table** from the Available Form Definitions list.
13. Click **OK**. A blank form appears.
14. Right-click anywhere on the blank form. Select **Properties** from the object inspect menu. The Table Edit Property view appears.

15. Click on the **Variables** tab.



16. Select the **Show All Variables** checkbox to show all the variables.

Refer to **Figure 7.3** for how these variables are used in the code.

17. In this form, we only want to display three variables:

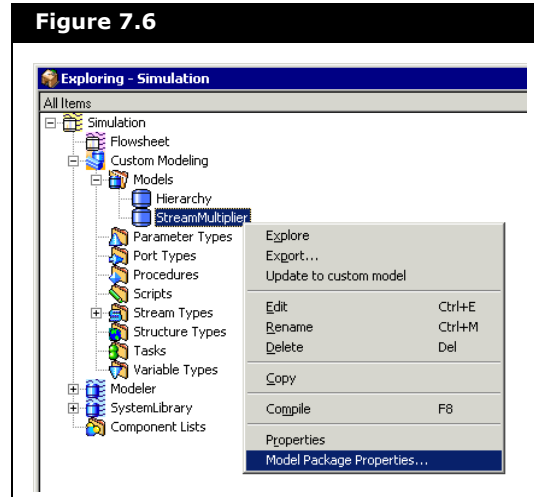
- **Flow Ratio.** This variable is a constant, and it is used to set the outlet flowrate equal to a multiple of the inlet flowrate (in other words,  $\text{Outlet1.F} = \text{Flow Ratio} * \text{Inlet1.F}$ ).
- **Inlet1.F.** This variable is the flow rate for the inlet stream.
- **Outlet1.F.** This variable is the flow rate for the outlet stream.

For other variables, select them and click the **Remove** button to remove them from the list.

18. Click **OK**. There should be three variables (i.e., Flow Ratio, Inlet1.F and Outlet1.F) listed in the Ratio form. Close the Table Edit Property view.

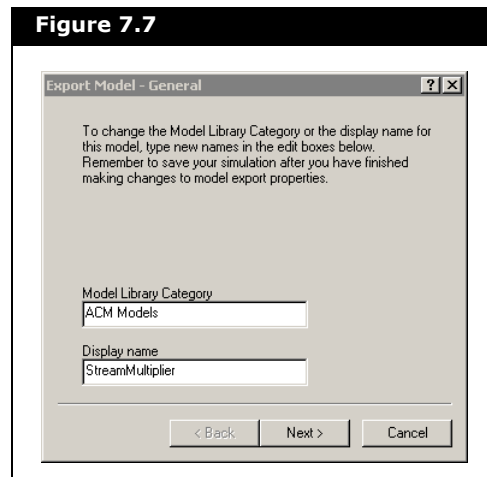
19. In the All Items pane, right-click on the **StreamMultiplier** sub-branch under the Models branch.

**Figure 7.6**



20. Select **Model Package Properties** from the object menu.  
The Export Model - General property view appears.

**Figure 7.7**

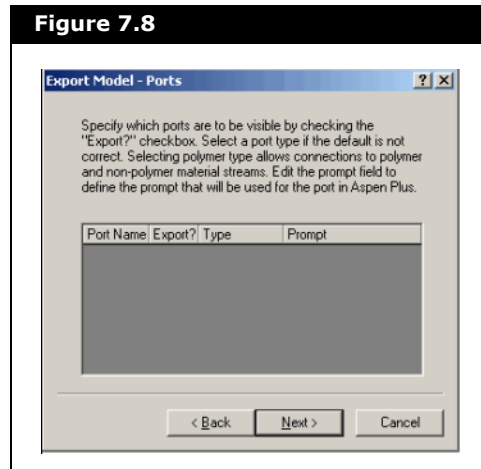


21. Keep the general settings as default. Click **Next**.



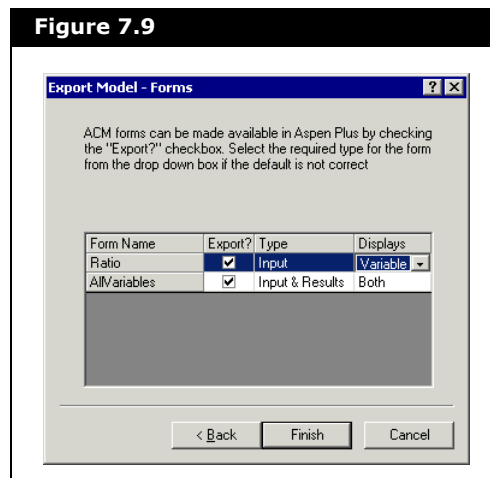
22. The Export Model - Ports property view displays the ports associated with the ACM model. Keep the default settings. Click **Next**.

Figure 7.8



23. The Export and Models property view displays all the forms associated with the ACM model. The AllVariables form is the standard form and it is created by default. For the Ratio form, open the drop-down list in the Displays column and select **Variables**.

Figure 7.9



24. Click **Finish**. The Export Model property view closes.
25. In the All Items pane, right-click on the **StreamMultiplier** model under the Models branch.

26. Select **Export** from the object inspect menu. The Export property view appears.
27. Select a directory that you want to export the model to. From the Save as Type drop-down list, select **Model Package (\*.msi)**.

**The Model Package has an \*.msi file extension. Although the exporting process creates a \*.dll file for the model package, the \*.dll file is actually wrapped inside of a single installation package that has an \*.msi file extension.**

28. Click **Save**.

**You must have Microsoft Visual Studio installed and properly added to the path with the correct environment variables settings. If the file fails to export, you can trace the source of any error in the Simulation Messages window.**

29. When the exporting process is completed, a StreamMultiplier Model Package Installer is generated in the directory you specified. ACM then automatically prompts you to select whether you want to start installing the model package. You can click **Yes** to begin the installation. If you click **No**, you can install the model package by double-clicking on the Model Package Installer to begin the installation.

## 7.2.2 Creating an Aspen Property File

The Aspen Property file (also known as the Aspen Plus Problem Definition file) defines the thermodynamics and component properties for the ACM Op.

To create an Aspen Property file from Aspen Plus:

1. Create a case in Aspen Plus.
2. From the **Run** menu, select **Run** to solve the case.
3. From the **File** menu, select **Save As**. The Save As dialog box appears.

4. Select a desired directory to save your case. From the Save As Type drop-down list, select **Aspen Plus Document (\*.apw)** as the file extension.

After you saved your Aspen Plus case, its corresponding property file is automatically generated in the same directory as where you saved your case. The property file will have the same name as the Aspen Plus case with a \*.appdf file extension.

Refer to [ACM Configs Page](#) for more information on Aspen Property file.

**You can also generate a property file with Aspen Properties.**

## 7.2.3 Adding an ACM Operation in HYSYS

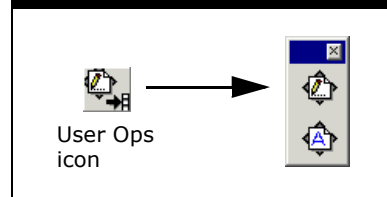
There are two ways that you can add an ACM Op to your simulation:

1. From the **Flowsheet** menu, select **Add Operation**. The UnitOps property view appears.  
You can also open the UnitOps property view by pressing **F12**.
2. In the Categories group, select the **All Unit Ops** radio button.
3. From the Available Unit Operation lists, select **ACM Oper**.
4. Click **Add**.

OR

1. From the **Flowsheet** menu, click **Palette**. The Object Palette appears.  
You can open the Object Palette by pressing **F4**.
2. Click on the **User Ops** icon. The User Ops Palette appears.

**Figure 7.10**

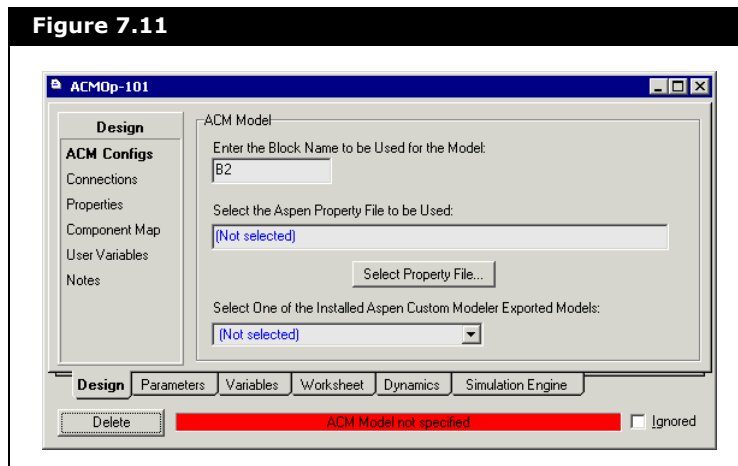


ACM Op icon

3. Double-click the **ACM Op** icon.

The ACM Op property view appears.

**Figure 7.11**



- To delete the ACM Op operation, click the **Delete** button. HYSYS will ask you to confirm the deletion. You can delete an ACM Op by clicking on the **ACM Op** object icon on the PFD and pressing the **DELETE** key.
- To ignore the ACM Op during calculations, select the **Ignored** checkbox. HYSYS completely disregards the operation (and cannot calculate the outlet stream) until you restore it to an active state by clearing the checkbox.

## 7.2.4 ACM Op Property View

## 7.2.5 Design Tab

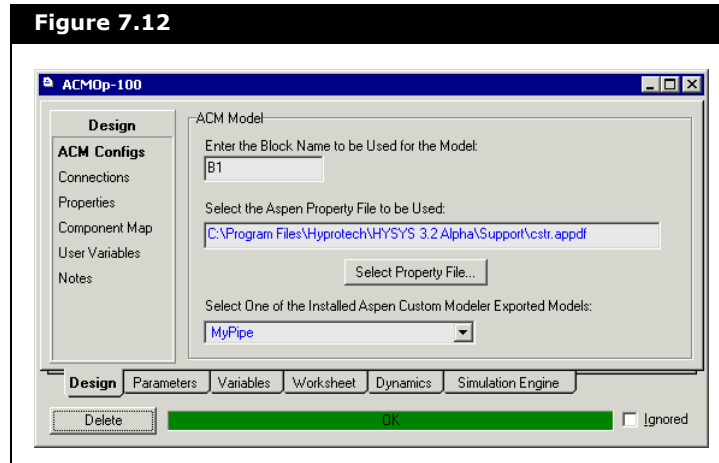
The Design tab consists of six pages:

- ACM Configs
- Connections
- Properties
- Component Map
- User Variables
- Notes

## ACM Configs Page

The ACM Configs page allows you to select an Aspen Property file, and ACM exported model for the ACM Op.

**Figure 7.12**



Refer to [Section 7.2.10 - Simulation Engine Tab](#) for more information.

**HYSYS automatically assigns a default Block Name to the ACM Op. You are not allowed to change this name because it has to be unique. The Block Name is displayed so that you can use it in the commands in the Simulation Engine tab.**

**You can change the unit name of the ACM Op (the name displayed on the PFD) in the Name field on the [Connections Page](#).**

Refer to [Properties Page](#) section for more information.

The Aspen Property file defines the components and property options for the ACM Op. You can click on the **Select Property File** button to open the browser to locate the path of the Aspen Property file. Only one Aspen Property file can be active at any time in the same simulation. The selected Aspen Property file is shared by all ACM Op instances. Property options and a sub-set of components can be selected for each instance as desired. Each time you select a new Aspen Property file, HYSYS will automatically update the properties of all ACM Op instances in all opened cases.

**Only one HYSYS case should be opened at any given time during ACM modeling.**

The Aspen Property file has two types of extensions:

- **\*.appdf**. This file is created by Aspen Plus. It can only be used if Aspen Plus is installed.
- **\*.aprpdf**. This file is created by Aspen Properties. It can only be used when Aspen Properties or the Aspen core components are installed.

**If neither Aspen Plus or Aspen Properties is installed, you are required to install the Aspen core components as part of the HYSYS installation. In this case, you should only use the Aspen Property files with an \*.aprpdf extension generated by Aspen Properties.**

**Some property files may cause the program to cause an exception error. If you get an exception error, try using a different property file and make sure that no warnings are generated for the property options when you selected them inside Aspen Plus.**

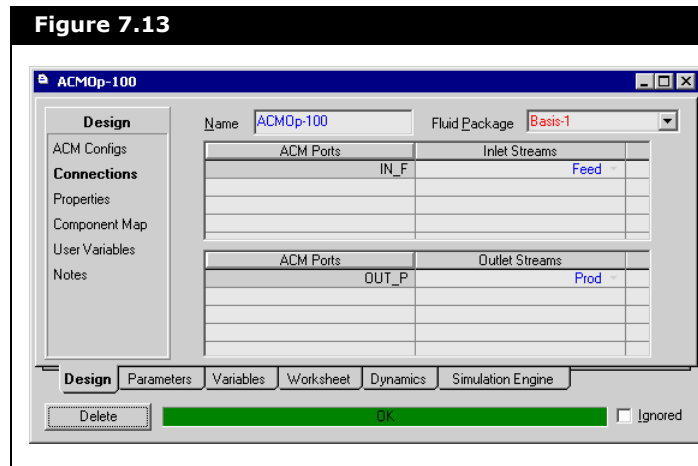
Refer to [Section 7.2.1 - Creating & Exporting an ACM Model](#) for more information on creating a model package installer.

After you select the Aspen Property file, you are required to select an ACM exported model from the **Select One of the Installed Aspen Custom Modeler Exported Models** drop-down list. The drop-down list only displays those ACM exported models that have been previously installed. An ACM exported model can be installed from its corresponding Model Package installer which contains the logic, equations, variables, and database required to define the functionality of the ACM Op.

## Connections Page

The Connections page displays all the ports in the ACM exported model, and allows you to define and connect a HYSYS material stream to match each port.

**Figure 7.13**



You can rename the ACM Op in the Name field and select a desired fluid package from the Fluid Package drop-down list.

**In HYSYS you cannot attach energy streams or controllers to the ACM Op. These situations can be simulated by declaring parameters or variables in your ACM model and then using the Spreadsheet or User Variables to transfer the values between HYSYS and the ACM model.**

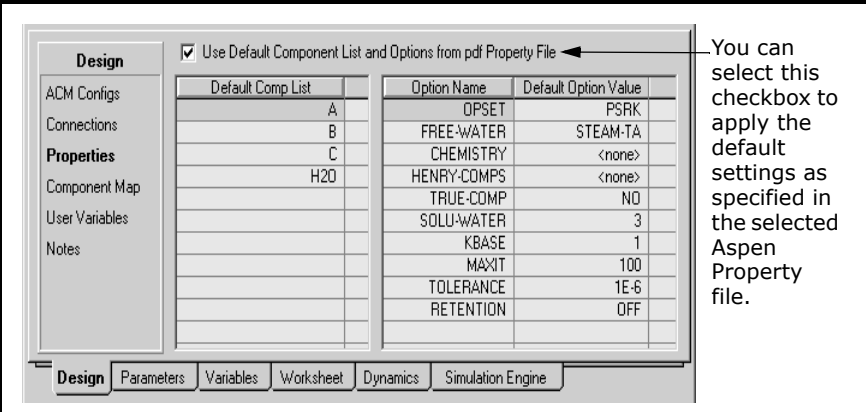
**HYSYS supports a number of different port types and it can operate on a subset of the ports supported by Aspen Plus. Additional port variables that are not recognized are treated as constants so that the model can still solve.**



# Properties Page

The Properties page displays the default settings obtained from the Aspen Property file. You have the option to apply the default settings, or change the property options and select a subset of components for the ACM Op as shown.

Figure 7.14

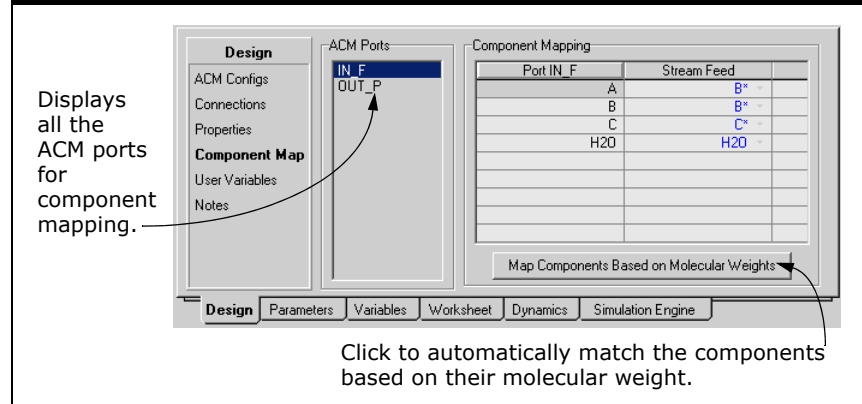


When you clear the **Use Default Component List and Options from pdf Property File** checkbox, you can select the Default Components individually by selecting their corresponding checkboxes in the Used column, and you can manipulate the values in the Default Option Value column as desired.

## Component Map Page

The Component Map page allows you to match the components from the Aspen Property file to the HYSYS component database. You can select an ACM Port in the ACM Ports group to view and map the associated components in the Component Mapping table.

**Figure 7.15**



**The Aspen Property file should contain all the components being used in the HYSYS simulation to ensure a match. If you get a component mismatch in your ACM Op you need to use a different Aspen Property file. Your model will not solve if there is no match between the HYSYS components and the ACM model components. A non-zero amount of material must be transferred from HYSYS to the ACM model.**

**Any unmapped components will be set to zero by default. You can also map multiple model components to the same HYSYS component where case they will be added up or equally divided.**

## User Variables Page

Refer to [Chapter 5 - User Variables](#) for more information on User Variables.

The User Variables page allows you to create and implement your own User Variables and code to the ACM Op. You can attach code written in a Visual Basic compatible macro language to the ACM Op and specify the executable conditions. This dynamically increases the internal functionality of the ACM Op to suite your specific modeling requirements. Since User Variables

cannot be distinguished from variables built into HYSYS objects, they can be added to spreadsheets, targeted by logic controllers, and have their values specified by user input.

## Notes Page

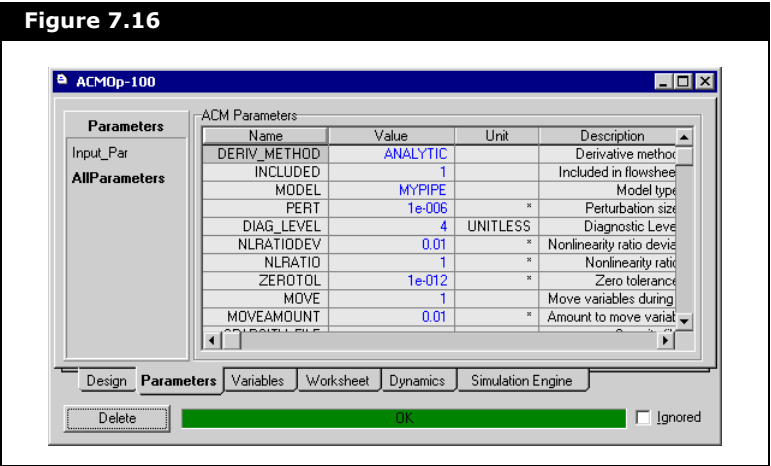
For more information, refer to [Section 7.19 - Notes Manager](#) in the **HYSYS User Guide**.

The Notes page provides a text editor where you can record any comments or information regarding the ACM Op or the simulation case in general.

## 7.2.6 Parameters Tab

The Parameters tab contains one standard page and other additional pages depending on the setup of the ACM exported model.

**Figure 7.16**



Refer to [Section 7.2.1 - Creating & Exporting an ACM Model](#) for more information on creating forms in ACM.

The AllParameters page is the standard page which displays the Name, Value, Unit, and Description for all the parameters imported from the ACM exported model. You can specify the value for each parameter as desired. The additional pages (or forms as they are referred to in ACM) are created in ACM and imported along with the ACM exported model. The additional pages allow you to organize the parameters that are of most interest to you in the ACM Op.

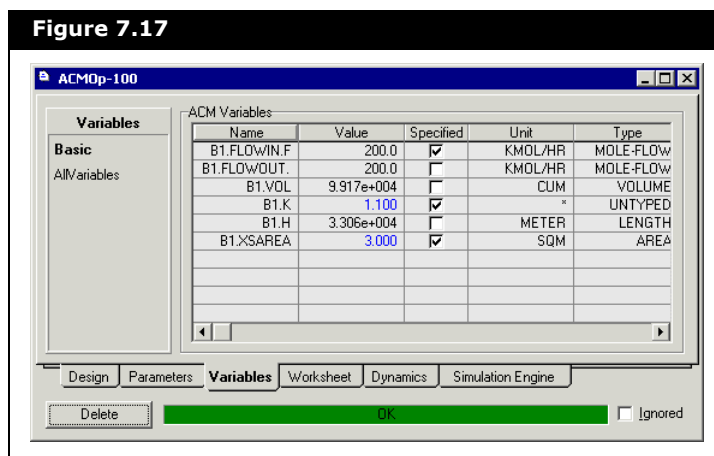
Refer to [Section 5.10 - Spreadsheet](#) in the **HYSYS Operations Guide** for more information on the Spreadsheet.

You can drag and drop the values of the parameters from the **AllParameters** page directly to the cells in the Spreadsheet operation. The values of the parameters can also be imported and exported via the Variable Navigator.

## 7.2.7 Variables Tab

The Variables tab consists of one standard page and other additional pages which are subject to the setup of the ACM exported model. The AllVariables page is the standard page and you can view all the variables' Name, Value, Unit, and Type for all the variables associated with the ACM exported model. The checkboxes in the Specified column indicate which variables are specified in the ACM model. The changeable variables are displayed in blue colour.

**Figure 7.17**



## 7.2.8 Worksheet Tab

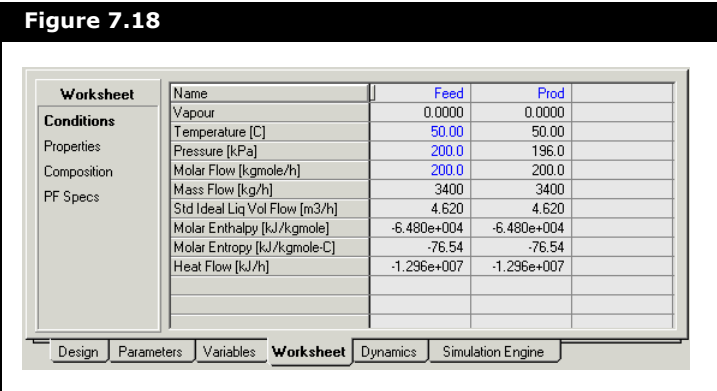
The Worksheet tab consists of four pages:

- Conditions
- Properties
- Composition
- PF Specs

# Conditions Page

Refer to [Section 12.2.1 - Worksheet Tab](#) in [Conditions Page](#) in the **HYSYS Operations Guide** for more information.

The Conditions page displays the default stream information as it is shown on the Material Streams tab of the Workbook property view. You can also view the conditions for the ACM streams by double-clicking on the Name field of the stream to open the Conditions page in the Material Stream property view.



**The enthalpy values for the inlet ports are calculated by HYSYS. These values should be used with caution by the ACM model as they might not be consistent with those in the Aspen Property file. In your ACM model, you can use a properties call to calculate a valid enthalpy based on the inlet temperature, pressure, and composition.**

## Properties Page

Refer to **Section 12.2.1 - Worksheet Tab** in the **Properties Page** in the **HYSYS Operations Guide** for more information.

The Properties page displays the properties for each ACM stream phase. You can also double-click on the Name of the stream to access the Properties page in the Material Stream property view. From there you can add or remove properties for an ACM Op stream. The properties from the Conditions page are not available on the Properties page.

**Figure 7.19**

| Worksheet   | Name                               | Feed    | Prod    |
|-------------|------------------------------------|---------|---------|
| Conditions  | Vapour Fraction                    | 0.00000 | 0.00000 |
|             | Temperature [C]                    | 50.000  | 50.000  |
|             | Pressure [kPa]                     | 200.00  | 200.00  |
| Composition | Actual Vol. Flow [m3/h]            | 4.4702  | 4.4702  |
| PF Specs    | Mass Enthalpy [kJ/kg]              | -3935.8 | -3935.8 |
|             | Mass Entropy [kJ/kg-C]             | -4.9288 | -4.9288 |
|             | Molecular Weight                   | 16.000  | 16.000  |
|             | Molar Density [kgmole/m3]          | 44.741  | 44.741  |
|             | Mass Density [kg/m3]               | 715.86  | 715.86  |
|             | Std Ideal Liq Mass Density [kg/m3] | 735.97  | 735.97  |
|             | Liq Mass Density @Std Cond [kg/m3] | 746.33  | 746.33  |
|             | Molar Heat Capacity [kJ/kmole-C]   | 68.963  | 68.963  |

Design Parameters Variables **Worksheet** Dynamics Simulation Engine

**In steady state, the ACM Op usually requires its inlet streams to be fully specified (solved) before the operation can solve the outlet streams.**

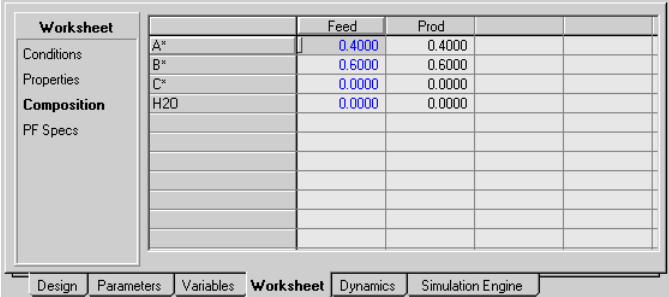
**HYSYS performs a T-P flash when information is transferred from the ACM model to a HYSYS stream. This can cause problems with narrow boiling streams where the temperature does not define how much vapour or liquid is present. You can avoid this problem by using multiple ports to separate phases.**

## Composition Page

Refer to [Section 12.2.1 - Worksheet Tab](#) in the **HYSYS Operations Guide** for more information on the choice of composition basis.

The Composition page allows you to specify the mole fraction for each component in the ACM Op streams. If you prefer to enter the composition using a different composition basis, you can open the Material Stream property view for the desired stream and select the composition input based on mole fractions, mass fractions, liquid volume fractions, molar flow, mass flow, or liquid volume flow.

**Figure 7.20**



| Worksheet   | Feed | Prod   |
|-------------|------|--------|
| Conditions  | A*   | 0.4000 |
| Properties  | B*   | 0.6000 |
| Composition | C*   | 0.0000 |
| PF Specs    | H2O  | 0.0000 |

## PF Specs Page

Refer to [Section 12.2.3 - Dynamics Tab](#) on [Specs Page](#) in the **HYSYS Operations Guide** for more information.

The PF Specs page allows you to activate and specify the pressure and flow specification for each stream in the ACM Op.

## 7.2.9 Dynamics Tab

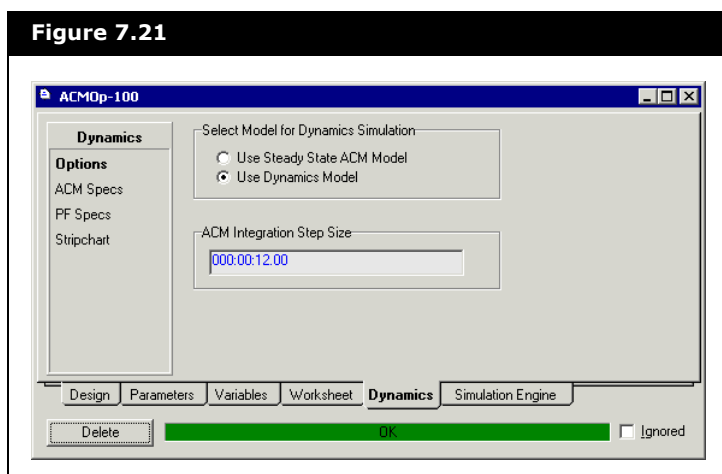
The Dynamics tab allows you to select the desired solver for the ACM Op. HYSYS Dynamics uses either the steady state sparse OOMF solver or the fixed step size implicit dynamic mode Euler solver to solve the ACM Op. There are five pages on the Dynamics tab:

- Options
- ACM Specs
- PF Specs
- Stripcharts
- Simulation Engine

## Options Page

The Options page allows you to select the operating mode of the ACM Op. If your model does not have dynamics behaviour or you require maximum calculation speed and optimal performance from your ACM Op, you can select the **Use Steady State ACM Model** radio button to have your model operating in steady state mode. For dynamics mode you can select the **Use Dynamics Model** radio button. Once you select dynamics mode for your model, the ACM Integration Step Size field appears, and you can specify a fixed integration time interval.

**Figure 7.21**



**The ACM Integration Step Size is set to 0.1 seconds by default.**

**For dynamics mode you need to fully specify the [ACM Specs Page](#) and [PF Specs Page](#).**

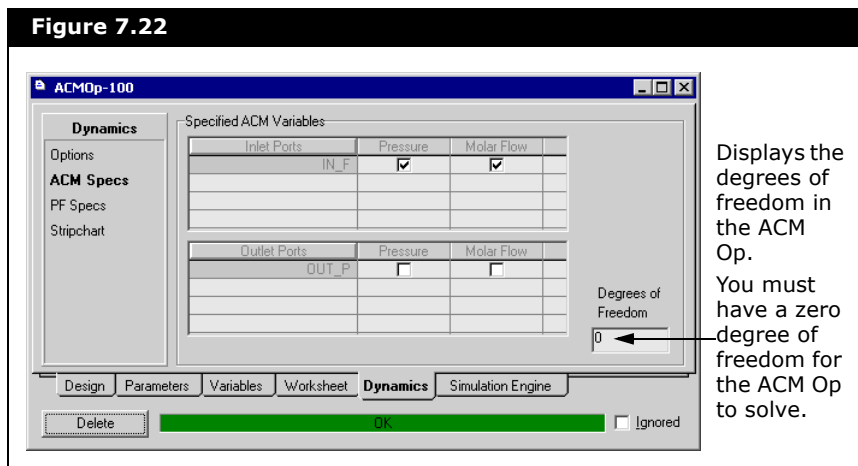
**The HYSYS and ACM model are not solved simultaneously. This may cause instabilities within the model in dynamics mode. To maintain stability, you can reduce the integration step size (of both HYSYS and the ACM model), apply intelligent damping inside the ACM model, and add vessels or volumes around the ACM Op depending on the version of AES.**



## ACM Specs Page

The ACM Specs page allows you to fix the pressure-flow variables for the inlet and outlet ports when the ACM Op is being solved. The checked variables are treated as constants in dynamics mode so that the model will have zero degree of freedom. For a typical model, the default option is to fix the inlet pressure and flow, which are updated with the values obtained from the HYSYS feed stream. The ACM Op will then calculate the outlet flow and pressure. Thus, generally the outlet pressure and flow are not fixed.

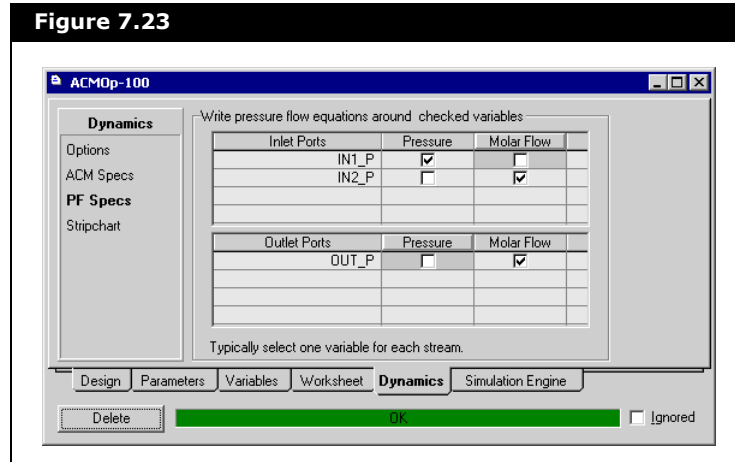
**Figure 7.22**



## PF Specs Page

The PF Specs page allows you to select HYSYS stream pressure and flow variables that are used to write the equations to the HYSYS pressure-flow solver. Typically you can select the same number of variables as the number of streams attaching to the ACM Op, and usually one variable for each stream is required to ensure the pressure-flow solver has the correct number of variables and equations to solve the model.

**Figure 7.23**



**Generally you should not select variables that are specified in HYSYS streams or in the model specification page.**

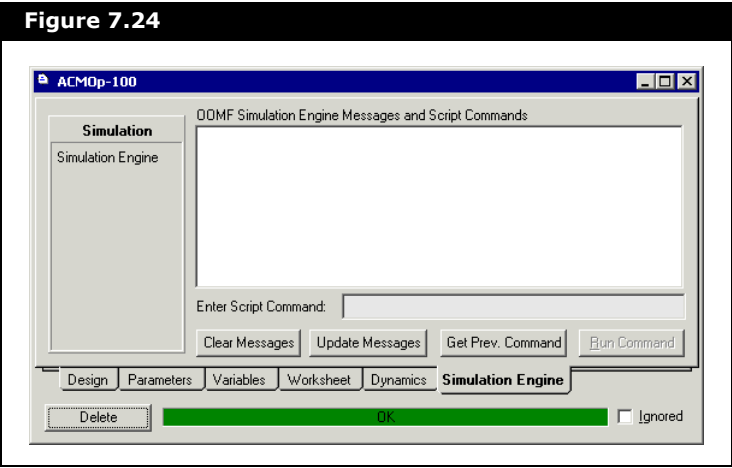
## Stripchart Page

The Stripchart page allows you to setup the stripchart for various variable sets. You can select the variable set by clicking the Variable Set drop-down list, and then clicking the Create Stripchart button to display the stripchart.

# 7.2.10 Simulation Engine Tab

The Simulation Engine tab allows you to enter OOMF script language commands for special tasks. For instance, you can print or retrieve a particular variable from the ACM Op. For more advanced usage, you can use the simulation engine for troubleshooting, or changing advanced options such as solver tolerances.

Figure 7.24



Refer to the **Aspen Plus OOMF Script Language** documentation for more information on OOMF script commands.

Some examples of OOMF script command:

- **print variables.** Prints a report for variables.
- **solve.** Solves the current problem.
- **help.** Displays the full list of EO commands.

The following table describes the objects available on the Simulation Engine page.

| Object                            | Description  |
|-----------------------------------|--|
| <b>Enter Script Command field</b> | Allows you to enter the OOMF script commands.  |
| <b>Clear Messages button</b>      | Clears all the existing messages in the OOMF script commands window.   |
| <b>Update Messages button</b>     | Checks for new simulation messages and appends them to the messages that are already in the OOMF script commands window. |

| Object                         | Description   |
|--------------------------------|---|
| <b>Get Pre. Command button</b> | Retrieves the previous command entered for editing or re-entry. |
| <b>Run Command button</b>      | Execute the command entered in the Enter Script Command field.  |

**If your model is not solving in steady state, you can perform the following troubleshooting procedures:**

1. Click the **Clear Messages** button to clear the text window.
2. Enter **solve** in the Enter Script Command field.
3. Press **ENTER**.

You can determine the sources of errors from the diagnostic messages in the Simulation Engine text window.

**OOMF script commands are intended for debugging convergence problems with the ACM models. Changes made via script command may or may not be saved with the HYSYS case.**

The Simulation Engine page also allows you to record commands that you enter and play them back again later using the Script Manager.

If you always need to make certain changes to the model before it solves, you can also create a User Variable inside the ACMOp to execute certain commands. For example, to always switch to the DMO solver before the ACMOp solves, you could write the following user variable method:

```
Sub PreExecute()
  Dim test As ACMOp
  Set test = ActiveCase.Flowsheet.Operations() ("ACMOp-100")
  test.ExecuteOOMFScriptCommand("solver dmo ")
End Sub
```



# A Customization FAQ

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## A.1 Automation FAQ

1. Whenever I change the Basis using Automation, HYSYS displays a property view "Do you want to be left in HOLDING mode..." which freezes the Automation application (Visual Basic, Excel, etc.). How do I make changes and avoid the property view?

Ans: When changing the Basis via Automation, use the following syntax:

```
hyCase.Solver.CanSolve = False
hyCase.BasisManager.StartBasisChange
{make Basis changes}
hyCase.BasisManager.EndBasisChange
hyCase.Solver.CanSolve = True
```

Where hyCase is a SimulationCase object. This will prevent the property view from appearing by putting the simulation into hold mode before making the Basis changes and taking the simulation out of hold mode once the Basis changes are complete.

2. How do I add a property package to HYSYS or change the existing property package using Automation?

Ans: HYSYS property packages must be referred to by their internal name when using Automation. A list of the name is below:

| Internal Name | External HYSYS Property Package Name |
|---------------|--------------------------------------|
| PengRob       | PR                                   |
| SRK           | SRK                                  |
| SourPR        | Sour PR                              |
| SourSRK       | Sour SRK                             |
| KDSRK         | Kabadi Danner                        |
| ZJRK          | Zudkevitch Joffee                    |
| PRSV          | PRSV                                 |
| Wilson        | Wilson                               |
| Uniquac       | UNIQUAC                              |
| Nrtl          | NRTL                                 |
| VanLaar       | van Laar                             |
| Margules      | Margules                             |

| Internal Name | External HYSYS Property Package Name |
|---------------|--------------------------------------|
| CNull         | Chien Null                           |
| ExtNRTL       | Extended NRTL                        |
| GenNRTL       | General NRTL                         |
| CS            | Chao Seader                          |
| GSD           | Grayson Streed                       |
| Antoine       | Antoine                              |
| BraunK10      | BraunK10                             |
| EssoTabular   | Esso K                               |
| AsmeSteamPkg  | ASME Steam                           |
| Steam84Pkg    | NBS Steam                            |
| Amine         | Amine                                |
| TabularPkg    | Tabular Package                      |
| LKP           | Lee-Kesler Plocker                   |

The text below is a HYSYS macro which demonstrates the above.

```

Sub Main
  Set hyApp = Application
  Set hyCase = hyApp.SimulationCases.Add("C:\Temp.HSC")
  Set hyBasis = hyCase.BasisManager
  Set hyFldPkgs = hyBasis.FluidPackages
  Set hyFldPkg = hyFldPkgs.Item(0)
  Set hyPropPkg = hyFldpkg.PropertyPackage
  hyFldPkgs.Add "Steam"
  Set hyFldPkg = hyFldPkgs.Item("Steam")
  hyFldPkg.PropertyPackageName = "asme steam"
End Sub

```

3. How do I use Automation to attach multiple feed and product streams to unit operations which can accept them (such as the tee, balance, separator, etc.)?

Ans: The Add method of the Feeds property is used to add multiple feed streams to a unit operation object one at a time.



For example, if hyMix refers to a Mixer unit operation object and hyFeed1 and hyFeed2 refer to material stream objects, the following syntax would add the material streams as feeds to the mixer.

```
hyMix.Feeds.Add hyFeed1  
hyMix.Feeds.Add hyFeed2
```

The same is true for the Products property of unit operations which can have multiple products. For example,

```
hyMix.Products.Add hyProduct1  
hyMix.Products.Add hyProduct2
```

The following code is a HYSYS macro which demonstrates the above.

```
Sub Main  
  ' This macro assume an active sheet which has the following  
  Streams: Feed1, Feed2, Product  
  Set hyCase = ActiveCase  
  Set hyFS = hyCase.Flowsheet  
  Set hyOps = hyFS.Operations  
  Set hyFeed1 = hyFS.MaterialStreams("Feed1")  
  Set hyFeed2 = hyFS.MaterialStreams("Feed2")  
  Set hyProduct = hyFS.MaterialStreams("Product")  
  ' Add a Mixer named Mix-100  
  hyOps.Add ("Mix-100", "MixerOp")  
  ' Set an Object reference To the Mixer  
  Set hyMix = hyOps.Item("Mix-100")  
  ' **Add feed Streams To the Mix-100 (must be added one at a  
  Time, can't use an Array of Streams)  
  hyMix.Feeds.Add hyFeed1  
  hyMix.Feeds.Add hyFeed2  
  hyMix.Product = hyProduct  
End Sub
```

4. How do I use Automation to refer to a stream name which is a number?

Ans: HYSYS assumes any variable which contains a number (regardless of whether it is text or numeric format) is an index number. For example,

```
Stream_Name = "2"
hyStream = Streams.Item(Stream_Name)
```

hyStream refers to the stream object with an **index number of 1**, not the stream named **1**. An index number is used to identify the order in which a stream was added. Thus in the above examples hyStream refers to the second stream added to the flowsheet, regardless of its name.

To be able to use numeric stream names, the following syntax must be used:

```
Stream = Streams.Item(CStr(Stream_Name))
```

CStr converts whatever is in the parentheses in to a string, regardless of its original format. Therefore, a **1** is interpreted as a "1" and **Feed** is interpreted as "Feed".

5. How do I obtain a viscosity (or WatsonK or surface tension or any number of other physical properties) from a **Fluid** object?

Ans: A viscosity cannot be obtained from the **Fluid** object, it must be obtained from the **FluidPhase** objects within the **Fluid** object (FluidPhases, VapourPhase, LightLiquidPhase, HeavyLiquidPhase). For example, if there is a heavy liquid phase then to obtain the viscosity (in HYSYS internal units of cP), the following syntax is used:

```
hyViscosity = hyFluid.HeavyLiquidPhase.ViscosityValue
```

where:

*hyFluid = a Fluid object*

6. How do I obtain component mass/molar/volume fractions from a Fluid object?

Ans: Unfortunately, the Fluid object differs from the ProcessStream object with regards to accessing component mass/molar/volume fractions. The following table shows the property object which is used to access the different types of component fractions from the Fluid and ProcessStream objects.

| Object        | Fluid                      | ProcessStream           |
|---------------|----------------------------|-------------------------|
| <b>Mass</b>   | MassFractions              | ComponentMassFraction   |
| <b>Molar</b>  | MolarFractions             | ComponentMolarFraction  |
| <b>Volume</b> | IdealLiquidVolumeFractions | ComponentVolumeFraction |

7. Why can't I use the Calculate or CalculateAsFluid methods to set a value as Calculated?

Ans: The Calculate and CalculateAsFluid methods can only be used in the Execute function of an extension unit operation.

8. Can I access the HYSYS Optimizer using Automation?

Ans: Unfortunately, the HYSYS Optimizer is not currently available to Automation. However, there is a workaround, which uses the SendKeys command. SendKeys is used to send keystrokes to an application as if they were typed at the keyboard. There are a few caveats:

- HYSYS must be visible to use the SendKeys command.
- HYSYS must be the active property view to use the SendKeys command, SendKeys does not wait between keystrokes, so if an application does not respond quickly enough, then SendKeys will fail. To reduce the possibility of SendKeys failing, a Windows "Sleep" function is used to add a 0.1 second pause between each keystroke.
- Since there is currently no way to determine when the HYSYS Optimizer has completed its calculations, the Windows "Sleep" function is used to wait a specified number of seconds for the HYSYS optimizer to solve. After this period of time, a user-defined check can be used to determine if the optimizer is complete. If not, the "Sleep" for another period of time and check again.

9. How do I determine if an object reference actually points to an object?

Ans: When an object reference is made, the reference may point to an object which does not exist. For example, when using the HYSYS Macro Language Editor, the ActiveCase object is an object reference to the currently open case. If no case is currently open, then the ActiveCase reference points to nothing. Use the Is keyword to compare the object reference to Nothing. The following code demonstrates this:

```
Set hyCase = ActiveCase
If hyCase Is Nothing Then
MsgBox "No HYSYS Case Is Open."
End If
```

10. How does HYSYS represent empty or null values internally?

Ans: HYSYS uses the integer -32767 to represent empty or null values. Empty values are shown as **<empty>** in HYSYS. For example, if Automation is used to access the temperature of a process stream on which a temperature has not been specified, a value of -32767 is returned.

11. How do I use HYSYS Macro Language (WWB) files?

Ans: In the HYSYS desktop, select **Macro Language Editor** command from the **Tools** menu. The HYSYS Macro Language Editor property view appears. Right-click anywhere on the Macro Language Editor property view, and select **File | Open** command from the Object Inspect menu. In the Open property view, select the HYSYS Macro Language (\*.WWB) file to open.

12. How do I access column specification values?

Ans: The column unit operation is special in that it has its own flowsheet. The flowsheet is where most information about the column is stored, so it must be used to access the column specifications. Access the column flowsheet as shown below (hyCase is an object reference to the simulation case, and A-100 is the column name):

```
Set hyCol = hyCase.Flowsheet.Operations.Item("A-100").ColumnFlowsheet
```

Now directly access the column specifications by name:

```
hyCol.Specifications("EtOH OH Mass Frac").GoalValue = 0.001  
hyCol.Specifications("MeOH Btms Mass Frac").GoalValue = 0.001
```

13. How do I access a SpreadSheet unit operation via Automation?

Ans: Use the following syntax:

```
Set SS = hyCase.Flowsheet.Operations.Item("SSName")  
A1Value = SS.Cell("A1").CellValue
```

Where, *hyCase* is a reference to the current HYSYS simulation case, *SSName* is the name of the spreadsheet being referenced in HYSYS, and *SS* is an object reference to the spreadsheet. The second line uses the *SS* object reference to set the value of the variable *A1Value* equal to the value of cell *A1* in the referenced spreadsheet.

14. Can I access HYSYS utilities via Automation?

Ans: Currently the HYSYS utilities cannot be accessed directly through Automation. However, the utilities (and most other objects in HYSYS) can be accessed indirectly by the SpreadSheet unit operation. Simply attach the utility inputs and results to the SpreadSheet and access the SpreadSheet via Automation as shown in #13.

15. How can I determine if HYSYS is already running?

Ans: The following code demonstrates how the *GetObject* function can be used to determine if HYSYS is currently running:

```
Set hyApp = GetObject(, "HYSYS.Application")
```

If HYSYS is not running, then the above line generates error number 429 in Office 97 and 483 in Office 95. Error trapping can be used to catch the error and determine if HYSYS is running. For example:

```
On Error GoTo ErrorTrap
Set hyApp = GetObject(, "HYSYS.Application")
'{Code here which will be executed only If HYSYS Is running}
Exit Sub
ErrorTrap:
If Err.Number = 429 Or Err.Number = 483 Then
    MsgBox "HYSYS Is Not currently running, please start HYSYS."
Else
    MsgBox "The following Error occurred: " & Err.Description
End If
```

**16. How do I make HYSYS visible when accessing it via Automation?**

Ans: By default, when HYSYS or a HYSYS simulation case is opened using Automation, it is a hidden process, with only the HYSYS splash screen indicating that HYSYS is running. The Visible Boolean property, available in both the Application and SimulationCase objects is used to make HYSYS visible to the user.

For example,

```
hyCase.Visible = True
```

*where:*

*hyCase = an object reference to HYSYS or a HYSYS simulation case.*

## A.2 Extensibility FAQ

### A.2.1 General Extensibility

1. What is the difference between registering the EDF instead of the DLL?

Ans: Registering the EDF allows you to interactively run and debug the extension using Visual Basic. However, a warning message will appear since no DLL was registered. If you want to interactively run and debug the reaction extension, use the following sequence:

- a. Register the EDF file. This displays a warning message which you can ignore.
- b. Click the Run button in Visual Basic. This brings up the debug property view.
- c. Load HYSYS and add a reaction.

If everything is working properly, your reaction extension will appear in the list. During this time, you can switch to Visual Basic and add breakpoints to check variable values, debug, etc. Once you are complete with debugging and want the reaction extension to be available, use the following sequence:

- a. Compile the reaction extension into a DLL.
- b. Register the DLL file.
- c. Load HYSYS and add a reaction. If everything is working properly, your reaction extension will appear in the list.

2. How can I interactively run an extension?

Ans: Use the following procedure:

- a. Register the extension definition file (EDF).
- b. Load the extension Visual Basic project (VBP) file, select **Project** command from the **View** menu and double-click on the class module (the file will have the \*.cls suffix).
- c. Right-click on an appropriate line of code and select **Toggle** command - **Breakpoint** sub-command from the Object Inspect menu. The line turns red, indicating a breakpoint at which the execution of the code will be paused.



Start icon

- d. Click the **Start** icon on the Visual Basic toolbar. The Debug property view appears.
- e. Load a HYSYS simulation case and install the extension by, pressing **F12** (to open the UnitOps property view) and double-clicking on name of the extension in the Available Unit Operations list.
- f. Select extension attachments and parameters as appropriate to make the extension calculate. When Visual Basic reaches the breakpoint in the extension, it will move in front of HYSYS. The code will be paused at the breakpoint. You can step through the code line-by-line interactively while the extension is running. Use the **F8** key to step through the code line-by-line and **F5** to stop stepping through the code and run the remainder non-interactively. While stepping through the code you can interactively view and set values in the Debug property view.  
For example, typing **?StreamName.TemperatureValue** and pressing **ENTER** will return the temperature of the stream named StreamName in HYSYS internal units (°C).

**HYSYS calls the extension three times (one Forgetting pass and two Execute passes). HYSYS is inactive while the extension is being stepped through.**

3. How do I reference streams and variables in the EDF?

Ans: Use the FindVariable method of the Container object. For example, the following code makes an object reference to the stream object with the Tag name "Feed" in the EDF.

```
Set hyFeed = hyContainer.FindVariable("Feed").Variable.Object
```

The following code makes an object reference to the real value object with the tag name "PrdTmp" in the EDF.

```
Set hyProdTemp = hyContainer.FindVariable("PrdTmp").Variable
```



4. When using **FindVariable** to set an object reference to an object in the EDF, when do I use *.Variable* and when do I use *.Variable.object*?

Ans: *.Variable* is used to access the value of variables in the EDF, such as numeric entry widgets, radio buttons, and so forth. *.Variable.object* is used to reference an object directly so that the extension is able to access the object properties and methods. Typically, *.Variable* is only used for EDF variables and *.Variable.object* is only used for process stream attachments.

5. How do I determine if an object reference actually points to an object?

Ans: When an object reference is made, the reference may point to an object which does not exist. For example, when FindVariable is used to set an object reference to an object in the EDF. If there is no object (for example, when a feed stream has not been attached), then the reference points to nothing. Use the **Is** keyword to compare the object reference to Nothing. The following code demonstrates this:

```
Set hyFeed = hyContainer.FindVariable("FeedStream") .Variable.Object
If hyFeed Is Nothing Then Exit Sub
```

## A.2.2 Unit Operation Extensions

1. What is the Container for a unit operation extension?

Ans: The `ExtnUnitOperationContainer` is the Container object for unit operation extensions. It contains the properties and methods which are available to them. You can view this object with an object browser (such as is contained in Visual Basic) or you can read the extension help file (`xhysys.hlp`) which is installed in the HYSYS directory when the extension SDK is installed.

2. What is the calculation sequence for an extension?

Ans: When a change is made to a variable which affects the extension, HYSYS performs a Forgetting pass and two Calculation passes. The Forgetting pass is used to identify the streams, unit operations, etc. affected by the change. The first Calculation pass is used to allow the extension to complete its internal calculations. The second Calculation pass is made so that external references made by the extension use correct values. If the extension makes no external references, then the second pass can be bypassed using the `SolveComplete` method of the Container object.

3. How do I prevent the second Calculation pass?

Ans: Add the following near or at the end of the Execute code.

```
hyContainer.SolveComplete
```

where:

*hyContainer = an object reference to the Container object made in the Initialize function*

This method of the Container object prevents the second Calculation pass from occurring. `SolveComplete` should only be used when the extension does not make an external reference to a product stream. If the extension makes no external references, then it is recommended that this line be included to increase efficiency and prevent other calculation

problems.

4. How do I set default values for numeric input or text boxes?

Ans: Use the following procedure:


Make object references to the numeric input boxes in the Initialize function and then set their defaults using the Value property. For example,

```
Set hyContainer = Container
Set hyEff = hyContainer.FindVariable("Eff").Variable
If IsRecalling = False Then hyEff.Value = ".50"
```

The first line sets an object reference to the container calling the extension unit operation. The second line sets hyEff as an object reference to the *eff* real number variable in the EDF. The Eff variable is the target moniker of a numeric input widget. The third line determines if the unit operation is being recalled from a saved case. If not, then the Value property of hyEff is set to 0.50.


5. How do I create an **Ignore This Unit Operation During Calculations** checkbox?

Ans: Use the following procedure:

- Add a standard checkbox to the extension property view.
- Double-click on the checkbox or right-click and select **Check Box Properties** command.
- Double-click the **Target Moniker** field or click the **Ellipsis** icon  directly beside it.
- Select **Object is Ignored in Calculations** from the Select Number Variable property view.
- Change the text in the Label field to **&Ignore Unit Operation**.

6. How do I create a Delete button?

Ans: Use the following procedure:


- Add a standard button to the extension property view.
- Double-click on the button widget or right-click and select **Button Properties** command from the Object Inspect menu.
- Double-click the **Message** field or click the **Ellipsis** icon  directly beside it.

- d. Click the **Insert** button.
  - e. Select **Delete Object** from the list and click the **OK** buttons on the Select Message property view and Edit Message property view.
  - f. Change the text in the Label field to **&Delete**.
7. How do I add Radio Buttons?

Ans: Use the following procedure:

- a. Go to the Views Manager property view and click the **Object Manager** icon beside the **Selected Objects** drop-down list.
- b. In the **Variables of Selected Object** matrix, type the Tag name in the Tag column, enter the name in the Name column, and select **Real Number** in the Type column. For example:

| Tag  | Name | Type        |
|------|------|-------------|
| List | List | Real Number |

- c. Select the **Persistent** checkbox and the **Triggers Solve** checkbox, select **None** in the N Dimensions drop-down list and select **Index** in the Numeric Type drop-down list.
- d. Close the Object Manager property view and open the form by double-clicking on it in the Existing Views list.
- e. Add a Radio Buttons widget and open the Radio Button Properties property view by double-clicking on the widget. Double-click the Target Moniker field or click the **Ellipsis** icon  beside it to open the Select Number Variable property view. Select the **Real Number** tag created in the Objects Manager property view and click the **OK** button.
- f. In the matrix at the bottom of the Radio Buttons Properties property view, add Labels for the Radio Buttons, the value sent to the extension when the Radio Button is selected, the X, Y and width of the Radio Button and its placement (justification).
- g. Save the \*.edf file.



Objects Manager icon

- h. In the extension code, use the value of the enumeration as appropriate:

| Code   | Description  |
|--|--|
| Dim hyRef as Object  | Dimension hyRef as an object in the declaration section.   |
| Set hyRef = hyContainer.FindVariable("Ref").Variable   | Use hyRef to set a reference to the <b>Status</b> object in the extension definition file (EDF).                 |
| Set hyRef = hyContainer.FindVariable("Ref").Variable<br>If IsRecalling = False Then<br>hyRef.Value = 0 | The <b>Initialization</b> function in the extension code is used to set the default value for the Radio Buttons. |

IsRecalling is only false when the extension is first added to the simulation, so that is when the default value of hyRef is set to 0, which corresponds to a Radio Button value.

8. How do I add status text and status colour?

Ans: Use the following procedure:



Objects Manager icon


- Go to the Views Manager property view and click the **Objects Manager** icon beside the **Selected Objects** drop-down list.
- In the Variables of Selected Object matrix, type the Tag name in the Tag column, enter the name in the Name column, and select **Real Number** in the Type column. For example,

| Tag    | Name   | Type        |
|--------|--------|-------------|
| Status | Status | Real Number |

Make sure the **Persistent** checkbox is selected, the **None** option is selected in the **N Dimensions** drop-down list, and that **Index** option is selected in the **Numeric Type** drop-down list.

- Close the Object Manager property view and open the form by double-clicking on it in the Existing Views list.
- Add **Static Text** objects of the exact same size in the exact same place on the bottom of the form (this can be easily accomplished using the Position and Size matrix). Give them appropriate Names (such as OK and Error), Background Colours (yellow for informative text, green for converging and converged and red for errors) and

Fixed Text (such as OK and Error). Select the **Framed** checkbox for each. Make sure the **Enable Moniker** field is empty.

- e. Create a Visibility Controller to view the Static Text objects:
  - i. Right-click on the form and select **Open Visibility Manager** command from the Object Inspect menu.
  - ii. Click on the **Create Controller** button and then click the **Edit** button.
  - iii. On the Visibility Controller Properties property view, enter **Status** in the Name field.
  - iv. Double-click the **Moniker** field or click the **Ellipsis** icon  directly beside it.
  - v. Select **Status** from the list (the object variable added earlier), and click the **OK** button.
  - vi. Type the Static Text object Labels in the Name column of the **States** matrix.
  - vii. Type in the same value for both the Low and High columns.

| Name  | Low | High |
|-------|-----|------|
| OK    | 0.0 | 0.0  |
| Error | 1.0 | 1.0  |

- viii. This value determines which Static Text object will be displayed.
- ix. Click the **Select Widgets** button. The names of the objects on the form appear in the first column and the names of the States added to the earlier matrix appear in the first row. For the Static Text objects added earlier named **OK** and **Error**, select the **Controlled** checkbox in the second column. For the **OK** Static Text object, select the checkbox under the **OK** column. For the Error Static Text object, select the checkbox under the **Error** column. For example,

| Controlled | OK | Error |
|------------|----|-------|
| OK         | X  |       |
| Error      |    | X     |

- x. Click the **OK** buttons to close the Visibility Controller Widget Selections property view and the Visibility Controller Properties property view.
- xi. The Visibility Controller for the Status is now shown on the Visibility Manager property view. Clicking on one of the

radio buttons displays the appropriate text.

xii. In the extension code to set the value of Status as appropriate:

f. Dimension hyStatus as an object in the declaration section. For example:

```
Dim hyStatus as Object
```

g. Use hyStatus to set a reference to the Status object in the extension definition file (EDF). For example:

```
Set hyStatus = hyContainer.FindVariable("Status").Variable
```

h. Set the value of hyStatus as appropriate to show the appropriate Static Text object. The message which will be shown based on the value that was determined in step #ix.

9. How do I add a drop-down (enumeration) list?

Ans: Use the following procedure:


- a. Go to the Views Manager property view and press the **Objects Manager** icon beside the Selected Objects drop-down list.
- b. In the Variables of Selected Object matrix, type the Tag name in the Tag column, enter the name in the Name column, and choose **Enumeration** in the Type column. For example,

| Tag  | Name | Type        |
|------|------|-------------|
| List | List | Enumeration |

- c. Select the **Persistent** checkbox and select the dimension in the **N Dimensions** drop-down list (none is for a single selection, vector is for an array of selections).
- d. Click the Enumeration Values button and type in the label (the text that will appear in the drop-down list) and the value (the value which will be used in the unit operation extension when an enumeration is chosen from the list).
- e. Close the Object Manager property view and open the form by double-clicking on it in the Existing Views list.



Objects Manager icon

- f. Add an Enumeration widget. Double-click on the Target Moniker field or click the **Ellipsis** icon  beside it and select the enumeration tag created in the Objects Manager. The number of entries in the drop-down list, the order in which they appear, and how they are matched can also be set here.
- g. Save the \*.edf file.
- h. In the extension code, use the value of the enumeration as appropriate:

| Code  | Description  |
|---|--|
| <code>Dim hyList as Object</code>                                   | Dimension hyList as an object in the declaration section.                                  |
| <code>Set hyList = hyContainer.FindVariable("List").Variable</code> | Use hyList to set a reference to the Status object in the extension definition file (EDF). |

#### 10. How do I force the simulation to solve?

Ans: Add a new sub-procedure named `VariableChanged` to the unit operation extension class module. This procedure is called whenever a variable in the extension is changed. An `InternalVariableWrapper` object is passed to it as an argument. This object is used to identify the name of the variable and take an appropriate action, such as triggering a solve. For example,

```
Public Sub VariableChanged(ByVal VariableName As InternalVariableWrapper)
  If VariableName.Tag = "Name" Then hyContainer.TriggerSolver
End Sub
```

If the `Tag` property of the `VariableName` object is equal to `NAME` then the `hyContainer` object uses the `TriggerSolve` method to triggers a solve. `NAME` is the name of the enumeration widget (or any other widget) in the EDF file.



hyContainer is an object referenced to the Container object which is made in the Function Initialize section of the class module. For example,

```
Public Function Initialize(ByVal Container As Object,
ByVal IsRecalling As Boolean) As Long
Initialize = extnCurrentVersion
Set hyContainer = Container
End Function
```

11. How do I add a single-column Matrix which lists one type of information (for example, Component names)?

Ans: Use the following procedure:

- Open the HYSYS Extension View Editor with the extension definition file (EDF) to be modified.
- Go to the Views Manager property view and click the **Objects Manager** icon beside the Selected Objects drop-down list.
- In the Variables of Selected Object matrix, enter the following in the **Tag**, **Name** and **Type** columns.




Objects Manager icon

| Tag            | Name           | Type Persistent | Triggers Solve | N Dimensions | Numeric Type |
|----------------|----------------|-----------------|----------------|--------------|--------------|
| ComponentNames | ComponentNames | Text Checked    | Cleared        | Vector       | N/A          |
| MatrixData     | MatrixData     | Real Checked    | Selected       | Matrix       | Index        |

ComponentNames is the Text object used to put the component names in the matrix column row and column header. MatrixData is the Real Number object used to hold the matrix data.

|                       |  |
|-----------------------|--|
| <b>Tag</b>            | Name which is used to access the object from Visual Basic.   |
| <b>Name</b>           | Alternate name used in the Extension View Editor (used to be more descriptive).                                    |
| <b>Type</b>           | The object type.   |
| <b>Persistent</b>     | Stores object values with the HYSYS simulation case.   |
| <b>Triggers Solve</b> | Will a change in the object force a solve.   |
| <b>Numeric Type</b>   | The type of real number. Index is used for unitless numbers. This only applies to objects of the Real Number type. |

- d. Close the Object Manager property view and open the extension property view by double-clicking on it in the **Existing Views** list.
- e. Add a Matrix widget by right-dragging from the Widgets Palette. View the Matrix properties by double-clicking on it.
  - i. **Vertical Direction** and **Sticky Last Entry** checkboxes should be cleared. **Multi-Selectable** checkbox should be selected.
  - ii. In the Labels group, the first drop-down list should be **Column**, the Show Units drop-down list should be **None** and the Left Width field should be **0**.
  - iii. In the Cells group, the Width field should be **50**, the Height field should be **9**, the Wrap field should be empty, the **Grids** drop-down list should be **Both** and the **Enter Motion** drop-down list should be **None** (this determines how the selected cell moves on the matrix when the user presses **ENTER**).
  - iv. The **Target Widget** drop-down list should be set to **<Self>**.
- f. Double-click on **MatrixDataSet1** in the Data Sets list or select **MatrixDataSet1** and click the **Edit** button.
  - i. Double-click on the **Moniker** field or press the **Ellipsis** icon  and select **ComponentNames** from the Select Number Variable property view.
  - ii. In the Label group, select the **Fixed** radio button and type **ComponentNames** in the field below the radio buttons.
  - iii. Select the **View Only** checkbox (this prevent the user from changing the values).
  - iv. Click the **OK** button to close the Data Set Properties property view.
- g. Click the **OK** button to close the Matrix Properties property view.
- h. Ensure that the Matrix widget is wide enough to accommodate a scroll bar on the right side if required. Typically, one-quarter of a column should be adequate.
- i. Save the \*.edf file.

Next add the following extension code:

j. Add the following to the global declarations section:

```
Dim hyComponentNames As InternalTextFlexVariable
Dim ComponentNames As Object
```

k. Add the following to the **Execute** function:

```
' Reference the variables ComponentNames variable In the EDF
Set hyComponentNames = hyContainer.FindVariable("ComponentNames").Variable
' Make an Object reference To the ComponentNames collection Object
Set ComponentNames = hyContainer.Flowsheet.FluidPackage.Components
' Set the size of the hyComponentNames vector using the SetBounds method
hyComponentNames.SetBounds ComponentNames.Count, 0, 0
' Set the values of hyComponentNames equal To the ComponentNames() vector
hyComponentNames.Values = ComponentNames.Names
```

12. How do I add a Component Matrix (a matrix with Component names along the row and column headers in to the body of which numbers can be entered)?

Ans: Use the following procedure:

- Open the HYSYS Extension View Editor with the extension definition file (EDF) to be modified.
- Go to the Views Manager property view and press the **Object Manager** icon beside the Selected Objects drop-down list.
- In the Variables of Selected Object matrix, enter the following in the Tag, Name and Type columns.







Objects Manager icon

| Tag            | Name           | Type Persistent | Triggers Solve | N Dimensions | Numeric Type |
|----------------|----------------|-----------------|----------------|--------------|--------------|
| ComponentNames | ComponentNames | Text Checked    | Cleared        | Vector       | N/A          |
| MatrixData     | MatrixData     | Real Checked    | Selected       | Matrix       | Index        |

ComponentNames is the Text object used to put the component names in the matrix row and column header. MatrixData is the Real Number object used to hold the matrix data.

|             |   |
|-------------|---|
| <b>Tag</b>  | Name which is used to access the object from Visual Basic.                      |
| <b>Name</b> | Alternate name used in the Extension View Editor (used to be more descriptive). |

|                       |  |
|-----------------------|--|
| <b>Type</b>           | The object type.   |
| <b>Persistent</b>     | Stores object values with the HYSYS simulation case.   |
| <b>Triggers Solve</b> | Will a change in the object force a solve.   |
| <b>Numeric Type</b>   | The type of real number. Index is used for unitless numbers. This only applies to objects of the Real Number type. |

- d. Close the Object Manager property view and open the extension property view by double-clicking on it in the Existing Views list.
- e. Add a Matrix widget by right-dragging from the Widgets list. View the Matrix properties by double-clicking on it.
  - i. **Vertical Direction** and **Sticky Last Entry** checkboxes should be cleared. **Multi-Selectable** checkbox should be selected.
  - ii. In the Labels group, the first drop-down list should be **Both**, the Show Units drop-down list should be **None**, and the Left Width field should be **45** (a good width for typical component names). Double-click on the **Moniker** field or click the **Ellipsis** icon  and select **ComponentNames** from the Select Text Variable property view.
  - iii. In the Cells group, the Width field should be **40**, the Height field should be **9**, the Wrap field should be empty, the Grids drop-down list should be **Both**, and the Enter Motion drop-down list should be **None** (this determines how the selected cell moves on the matrix when the user presses **ENTER**).
  - iv. The Target Widget drop-down list should be set to **<Self>**.
- f. Double-click on **MatrixDataSet1** in the Data Sets list or select **MatrixDataSet1** and click the **Edit** button.
  - i. Double-click on the Moniker field or click the **Ellipsis** icon . Select MatrixData from the Select Number Variable property view and click the **OK** button.
  - ii. In the Label group, select the **Moniker** radio button and double-click in the field or click the **Ellipsis** icon . Select **ComponentNames** from the Select Text Variable property view and click the **OK** button.
  - iii. Select the number format desired by double-clicking the **Format** field or clicking the **Ellipsis** icon . Typically **0.5** fixed is best for interaction parameters.
  - iv. Enter the text used when a cell is empty in the matrix in the

**Empty Text** field. **<empty>** is the HYSYS standard.

- v. Enter the text used when a cell is uneditable in the Matrix in the **Hidden Text** field. **---** is the HYSYS standard, though the default value listed is **\*\*\***.
- vi. In the Units group, the **Auto** radio button should be selected, **Shows Units in Cell** and **Hide Units in Label** checkboxes should be cleared.
- vii. Click the **OK** button to close the Data Set Properties property view.
- g. Click the **OK** button to close the Matrix Properties property view.
- h. Save the \*.edf file.

Next add the following extension code:

- i. Add the following to the global declarations section:

```
Dim ComponentNames As InternalTextFlexVariable  
Dim MatrixData As InternalRealFlexVariable  
Dim DummyMatrix As Variant
```

j. Add the following to the **Initialization** function:

#### Code

```
Set ComponentNames = hyContainer.FindVariable("ComponentNames").Variable
Set MatrixData = hyContainer.FindVariable("MatrixData").Variable
' IsRecalling Is only False when the extension Is first added To the
simulation.
If IsRecalling = False Then
    Set hyComponents = hyContainer.Flowsheet.FluidPackage.Components
    ComponentNames.SetBounds hyComponents.Count, 0, 0
    ComponentNames.Values = hyComponents.Names
    DummyMatrix = MatrixData.Values
    ReDim DummyMatrix(hyComponents.Count, hyComponents.Count)
    ' This Is used To Set default values For the matrix. Note that the
    diagonal Is Set To -32768, which makes it uneditable
    For i = 0 To hyComponents.Count - 1
        For j = 0 To hyComponents.Count - 1
            If i = j Then
                DummyMatrix(i, j) = -32768
            Else
                DummyMatrix(i, j) = 0
            End If
        Next j
    Next i
    MatrixData.SetBounds hyComponents.Count, hyComponents.Count, 0
    MatrixData.Values = DummyMatrix
End If
```


k. Add the following to the **Execute** function:

```
DummyMatrix = MatrixData.Values
For i = 0 To hyComponents.Count - 1
    For j = 0 To hyComponents.Count - 1
        if i = j Then DummyMatrix(i, j) = -32768
    Next j
Next i
MatrixData.Values = DummyMatrix
```

13. How do I change the name of an unit operation extension in the PFD?

Ans: A Text Entry widget must be added to the EDF file to allow the name of the extension to be changed.

Use the following procedure:

- a. Add a **Static Text** widget and double-click it or right-click and select **Static Text Properties** command from the Object Inspect menu.
  - b. Change Fixed Text to **&Name**. The **&** is used to determine the hot key for the property view. (**ALT** + hot key gives the focus to this widget). The hot key is shown as underlined.
  - c. Add a **Text Entry** widget and double-click it or right-click and select **Text Entry Properties** command from the Object Inspect menu.
  - d. Double-click the **Target Moniker** field or click the **Ellipsis** icon  directly beside it, select **Object Name** from the Select Text Variable list and click the **OK** button.
14. How do I set the compositions of a stream in HYSYS?

Ans: Compositions must be set using a Variant array which has been initialized. To initialize the array, set it equal to the ComponentMolarFractionValue, ComponentMassFractionValue, or ComponentVolumeFractionValue of the stream whose compositions are going to be changed.

The following code demonstrates this:

```
Dim Compositions As Variant  
Compositions = hyFeed.ComponentVolumeFractionValue  
Compositions(0) = .5  
Compositions(1) = .2  
Compositions(2) = .3  
hyFeed.ComponentVolumeFraction.Values = Compositions
```

where:

*hyFeed = an object reference to a material stream in HYSYS*

## 15. How do I display results in the EDF?

Ans: Use the following procedure:

- a. Open the HYSYS Extension View Editor with the extension definition file (EDF) to be modified.
- b. Go to the Views Manager property view and press the **Object Manager** icon beside the Selected Objects drop-down list.
- c. In the Variables of Selected Object matrix, enter the Tag, Name and Type of the variables which are to be displayed. Ensure that the **Persistent** checkbox is selected, the **Triggers Solve** checkbox is cleared, **N Dimensions** is **None**, and the selected Numeric Type as appropriate.
- d. Add **Static Text** widgets to the EDF to describe the output data. Add **Numeric Input** widgets beside the appropriate description. Double-click the **Numeric Input** widget or right-click and select **Numeric Input Properties** command from the Object Inspect menu.
- e. Select the **View Only** checkbox. Select the appropriate variable in the **Target Moniker** field.
- f. Add the following code to the extension:

```
hyContainer.FindVariable("EDFVariable").Variable = ExtnVariable
```

where:

*EDFVariable = the name of the variable in the EDF and ExtnVariable is the name of the variable in the extension code whose value is going to be displayed in the EDF*

## 17.) How do I make a button perform a calculation when clicked?

Ans: Use the following procedure:

- a. Open the HYSYS Extension View Editor with the extension definition file (EDF) to be modified.
- b. Go to the Views Manager property view and click the **Object Manager** icon beside the Selected Objects drop-down list.



Objects Manager icon




Objects Manager icon



- c. In the Variables of Selected Object matrix, enter the following:

| Tag          | Name          | Type    |
|--------------|---------------|---------|
| ActionButton | Action Button | Message |

The **Triggers Solve** checkbox should be selected or cleared as appropriate if the calculations affect the extension.

- d. Add a **Button** widget to the EDF. Double-click the Button widget or right-click and select **Button Properties** command from the Object Inspect menu.
- e. Change the Label to **&About**.
- f. Double-click on **Message** field or click on the **Ellipsis** icon  beside it. Click the **Insert** button, and select **AboutButton** from the Select Message list.
- g. Click the **OK** buttons to close the Select Message property view, Edit Message property view, and Button Properties property view.
- h. Add the following Public Sub to the unit operation extension code:

```
Public Sub VariableChanged(ByVal VariableName As InternalVariableWrapper)
On Error GoTo ErrorCatch
If VariableName.Tag = "AboutButton" Then
    {Enter you code here}
End If
ErrorCatch:
End Sub
```

When a variable is changed in the EDF, Sub VariableChanged is executed if it is present. The Code above checks the Tag of the variable which was changed, if the tag of the variable is AboutButton, then the code in the braces is executed. Custom calculation code is entered between the braces.

16. How do I automatically set the Calc Level (calculation level) of an extension?

Ans: Add the following to the Initialize function of the extension code:

```
Set hyContainer = Container
Set hyInterface = hyContainer.ExtensionInterface
hyInterface.CalcLevel = 1000
```

where:

*Both hyContainer and hyInterface are declared as Objects*

17. How do I automatically attach an existing stream to a Unit Operation Extension when it is added to the PFD?

Ans: In the Initialize function of the extension, make an object reference to the stream which will be attached to the extension. Then use FindVariable to set the name of the stream defined in the EDF equal to the stream object reference.

The following code demonstrates this:

```
Dim hyFeed As Object
Set hyFeed = hyContainer.Flowsheet.MaterialStreams("Feed")
hyContainer.FindVariable("Feed").Variable.Object = hyFeed
```

18. What is a "Forget" Pass?

Ans: HYSYS unit operations can calculate "product" variables based on "feed" variables, "feed" variables based on "product" variables, or a combination of the two. This can lead to very complicated interdependency between the variables in a flowsheet. When a variable is changed, HYSYS must first "forget" all of the variables that were calculated based on the original value, and then re-calculate based on the new value. If the values are not forgotten, an attempt to calculate a new value is misinterpreted by HYSYS as an inconsistency.

To illustrate this, assume that the temperature of the inlet stream to a unit operation is changed from 10°C to 41°C.

The following sequence occurs:

- a. The stream will "forget" its temperature, as well as any variables it calculated based on temperature (e.g., vapour fraction, density).
- b. The unit operation will get an Execute pass, with IsForgetting = True. If the unit operation asks its inlet stream for any of the forgotten variables it will receive **<empty>** (which can be an E\_FAIL error, or the value - 32767).
- c. The unit operation is unable to calculate any of the variables it had calculated based on the inlet stream's forgotten variables. HYSYS causes these variables to be forgotten as well. Their owners (e.g., the unit operations's outlet stream) will then receive a similar Execute.
- d. When the Forget pass has propagated through the flowsheet, the inlet stream recalculates using the new temperature value. An Execute pass - with IsForgetting = False - will propagate through the flowsheet.

19. What should my Execute do during a Forget?

Ans: Given the above description of the purpose of the Forget pass, it would seem to make sense for a unit operation's Execute to return immediately if IsForgetting = True. All of the variables it had calculated would be 'forgotten' by HYSYS, but recalculated during the subsequent Execute. If a unit operation's Execute performs no calculations during the Forget pass, this is exactly what will happen. Indeed, this is a valid method for a unit operation. Neglecting to perform any calculations during a forget will not cause any errors, but can cause some inefficiency because more variables than necessary are forgotten.

If efficiency becomes a concern, a solution may be to calculate some variables during the Forget. Non-extension unit operations generally calculate as much as possible during their Forget, so as to minimize unnecessary propagation of the Forget. As an example, consider a Cooler operation that has the following specification:

- Inlet Pressure
- Inlet Temperature

- Pressure Drop
- Outlet Temperature

The Cooler calculates its Duty and Outlet Pressure based on these values. If the inlet temperature is changed, the Cooler will get a Forget, in which the inlet temperature appears **<empty>**, but the inlet pressure is available. If the Cooler does not calculate anything, the outlet Pressure will be forgotten, and the Forget will propagate through all objects downstream of the Cooler. If, however, the Cooler re-calculates its outlet pressure during the Forget, the outlet stream will remain fully calculated, and will not receive any Execute calls. Only the Cooler's duty will be forgotten.

It is important for any unit operation to avoid using variables that it has previously calculated for the calculation of other variables. In the above example, the Cooler can "see" its outlet temperature and its duty (which it had calculated) during its Forget. These two values can (erroneously) be used to calculate its inlet temperature. In this case, this would cause an inconsistency error, as the calculated value would not match the new specified value. Often, the problem is subtler, and results in the two values being calculated, each thinking that the other is a specification. To avoid this, the Cooler must check that it is not a variable's "CalcBy" object, before using that variable's value to calculate other variables.

## 20. Why do I get Three Execute calls?

First-time extension writers are almost always surprised to receive a second non-Forgetting Execute call from HYSYS. In fact, non-Extension unit operations only receive two Execute passes. An additional Execute is necessary for some extensions that need to see the results of the **Balance** calls they make during their Execute.

When a unit operation calculates a value to a stream's variable, the unit operation cannot then "see" the value until the stream has recalculated. If the unit operation calculates a stream's temperature during its Execute, and needs to use the stream's temperature later in the Execute, it will not be able to ask the stream for the value. When the unit operation's Execute knows the value (as in this case), it can simply keep the value itself as long as it needs to.

A problem arises when the unit operation uses a "Balance" call to calculate the compositions and flow of its streams. The "Balance" performs all the logic to detect which values are specified and which need to be calculated, combines multiple feeds to produce a single product, etc., all without the unit operation needing to be aware of the calculations. Unfortunately, the results of these calculations will be unavailable to the unit operation until after the streams have had their Executes. If the unit operation wants to display, e.g., the flow of a key component in each of its attached streams, these values will be unavailable. However, the unit operation will receive a third Execute, after the streams have had theirs, during which the values "Balance" had calculated will be available. Proper use of the third Execute for this purpose is tricky, as the unit operation must avoid repeating the work of the previous Execute.

Relatively few unit operations require the third Execute call. If a unit operation can perform all of its calculations in the first Execute, it should call "SolveComplete", which will prevent the third Execute call from being made by HYSYS.

21. Why is my Unit Operation's PFD icon yellow?

Ans: HYSYS will outline a unit operation in yellow if it cannot complete its calculations. Usually, the unit operation uses its StatusQuery method to provide the user with a specific reason why the solve can not be completed, but the "Not Solved" warning is provided by default.

To prevent this warning from being added, the unit operation must call "SolveComplete" when it has satisfactorily completed its calculations. This unit operation's Execute is responsible for determining whether it has calculated all of the variables it wants to calculate.

## A.2.3 Kinetic Reaction Extensions

1. What is the Container for a Kinetic Reaction Extension?

Ans: The `ExtnKineticReactionContainer` is the Container object for Kinetic Reaction Extensions. It contains the properties and methods which are available to them. You can view this object with an object browser (such as is contained in Visual Basic) or you can read the extension help file (`xhysys.hlp`) which is installed in the HYSYS directory when the extension SDK is installed.

2. Why is the **Triggers Solve** checkbox greyed out in the Objects Manager in the EDF?

Ans: For Kinetic Reaction Extensions, the **Triggers Solve** checkbox must always be selected, which is why it is disabled (greyed out).

3. How do I access the liquid phase if my reaction only occurs in the vapour phase? If I select combined phase, then my reaction rate changes.

Ans: HYSYS multiplies the reaction rate, which you pass to it, by the volume of the phase selected. This is wherein the problem lies as HYSYS should actually only use the volume of the Liquid Phase instead of the volume of the Combined Phase. Here is the workaround:

| Code   | Description   |
|--|---|
| <code>hyContainer.Phase = ptCombinedPhase</code>             | Set the <b>Phase</b> property to <b>ptCombinedPhase</b> .   |
| <code>Temp = Fluid.HeavyLiquidPhase.MolarDensityValue</code> | Access the Liquid phase for your rate calculations (make sure to identify it as <b>HeavyLiquidPhase</b> or <b>LightLiquidPhase</b> ). |
| <code>rate = rate * (1 - Fluid.VapourFractionValue)</code>   | Multiply the rate you calculate by (1 - <code>Fluid.VapourFractionValue</code> )  |

The corrected rate will now be used by HYSYS.



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