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Part I
Introduction

1 Read This First

1.1 The Scope of the Guide

This guide introduces the facilities provided by Cadcentre for the design and documentation of logically interconnected piping networks for a wide range of process and related plant design industries, both on–shore and off–shore. It assumes that you are already familiar with pipework design practices, but does *not* assume any prior knowledge of computer–aided design systems.

The guide explains the main concepts underlying PDMS and its supporting applications, and shows how you can apply these to your own design projects. A key feature of the guide is a **hands-on tutorial exercise** which is incorporated throughout, allowing you to gain practical experience of the ways in which you can use PDMS as you learn about the powerful facilities which it provides.

This guide does *not* give step–by–step instructions on how to carry out specific design functions, since you can access such information as you work by using the **on–line help facilities** incorporated into the program's graphical user interface. You will be told how to do this at an early stage.

For fuller information about all aspects of pipework design (and other related disciplines) using PDMS, refer to the sources listed in Appendix C of this guide.

1.2 Learning to Use PDMS

The aim of this guide is to help you to learn to use PDMS and its supporting applications for your piping design work as quickly as possible. Once you have grasped the basic principles, you will find that most operations quickly become intuitive.

The best way to learn is to experiment with the product for yourself. To facilitate this, the initial chapters of the guide comprise two concurrent sequences of information:

- A **hands-on tutorial exercise**, which gives a step-by-step practical introduction to the ways in which you might use the applications.
- Explanations of the **underlying concepts**, given at the points at which each is first encountered as the exercise progresses.

The intention is that you should work progressively through the exercise, pausing to learn about each new concept as it is introduced. All steps which make up the exercise are numbered sequentially throughout the guide. The start and end of each part of the exercise are marked by lines across the page to separate them from the general information sections, like this:

1.3 Further Training in the Use of PDMS

Although this guide will teach you to understand the key features of using PDMS for your pipework designs, it cannot possibly show you all of the wide-ranging facilities to which you now have access, nor can it identify the best ways in which you might use the program to suit your own individual design practices.

To get the best out of PDMS, it is important that you receive proper training in its use from a qualified instructor, who can answer your questions as they arise and give you advice on tailoring your techniques to best match your objectives. A wide range of training courses are provided by Cadcentre Ltd, covering all levels of expertise and all design disciplines. To arrange attendance on such a course, contact your nearest Cadcentre support office for further details (see the copyright page at the front of this guide for a link to our web site).

1.4 Some Terms and Conventions

As you might imagine, a program with the wide-ranging power of PDMS is necessarily large and, if you had simultaneous access to all of its features, could be rather daunting. To make the whole program easily controllable, it is subdivided into convenient functional parts. These are referred to throughout this guide by the following terms:

- **Modules** are subdivisions of PDMS which you use to carry out specific types of operation. You will be mainly concerned with two modules only: **DESIGN**, used for creating the 3D design model and **ISODRAFT**, used for generating annotated and dimensioned isometric drawings of your design.
- **Applications** are supplementary programs, used in conjunction with PDMS, which have been tailored to provide easy control of those operations which are specific to particular disciplines. The application which we will be using for our piping design work is the **Pipework Application** (plus a brief introduction to the **Equipment Applicaton**).

You can switch rapidly between the different parts of the program, so that the distinctions between them become almost imperceptible, but you need to recognise what is happening when you select from the different functions available to you from the various menus.

The following terms and conventions are used throughout this guide to describe what action to carry out:

Term	**Description**
Click	Place the mouse cursor over a specified point, then quickly press and release the designated mouse button. If no button is specified, always use the *left-hand* mouse button.
Double-click	Place the mouse cursor over a specified point, then click the left-hand mouse button twice in quick succession.
Pick	Click on the required item to select it.
Drag	Place the mouse cursor over a specified point, then press and *hold down* the designated mouse button while moving the cursor to a second specified point. Release the button over the second point.
Enter	Type text into the specified dialogue box, then press the **Enter** (or **Return**) key to confirm the entry.

1.5 How the Guide is Organised

This guide is divided into three parts, including some appendices, as follows:

- **Part I** (this part) introduces the guide itself and the pipework application which it describes.
  - **Chapter 1** (this chapter) summarises the scope of the guide.
  - **Chapter 2** gives a general overview of the main design facilities provided within the pipework application.
- **Part II** explains, with the help of a worked example, some essential concepts which you need to understand when you use the pipework application.
  - **Chapter 3** gives you a general guide to using the PDMS graphical user interface, including an explanation of how to access detailed on-line help. If you are already familiar with similar forms and menus interfaces, you should be able to read through this chapter rapidly. Do not ignore it altogether, however, as it tells you how to load the pipework design application which forms the basis for the tutorial exercise.
  - **Chapter 4** explains how PDMS stores its design data and shows you how to organise your data.
  - **Chapter 5** demonstrates how to create some simple items of equipment. Although not strictly part of the piping design process, the steps described in this chapter introduce you to the ways in which the design applications work and result in some reference points between which to route pipe runs in later parts of the exercise.
  - **Chapter 6** explains the key features of piping design using PDMS and shows you how to build up a piping sequence component by component.
  - **Chapter 7** shows how to check your design for errors and inconsistencies, and how to generate reports and isometric plots directly from the design data.

- **Part III** comprises the following set of reference appendices:
  - **Appendix A** shows the complete hierarchy of all options available from the application bar menus, pull-down menus and submenus in a convenient quick-reference format.
  - **Appendix B** summarises the database hierarchy which PDMS uses to store your piping design data.
  - **Appendix C** identifies other sources of information which supplement, and expand upon, the brief details given in this guide.
  - **Appendix D** contains some examples of the types of isometric plot, including material take-off lists, which can be produced easily by using PDMS.
- The guide concludes with an **Index**, allowing you to refer back to any specific topics about whose details you need to be reminded.

2 What PDMS Offers You

PDMS plus the CADCENTRE pipework and related applications provide a powerful suite of facilities for the creation, analysis and documentation of logically interconnected piping networks. The design modelling functions incorporate a degree of 'intelligence' which, where possible, makes sensible decisions about the consequential effects of many of your design changes, so that you can implement a sequence of related changes with a minimum of effort.

The emphasis throughout is on maximising both design consistency and design productivity, so that you need only make a minimum number of essential design decisions in order to create a reliable and fully documented piping design ready for fabrication and erection. Modifications to your design may be incorporated at any stage without fear of invalidating any of your prior work, since data consistency checking is an integral part of the product. PDMS automatically manages drawing production, material take-off reports, etc., by reading all design data directly from a common set of databases, so that there can be no errors introduced by transcribing information between different disciplines.

The applications let you check all aspects of the design as the work progresses, including on-line interdisciplinary clash detection, so that the chances of errors and inconsistencies reaching the final documented design are reduced to an exceptionally low level. The need for expensive on-site modifications is thereby avoided.

The applications, which have been designed by piping engineers for piping engineers, are controlled from a graphical user interface. This means that all design, drawing and reporting operations are initiated simply by selecting choices from simple menus and entering data into the appropriate fields on on-screen forms. In some cases the command options are represented by pictorial icons rather than by words, thus simplifying the user interface still further. Should you need guidance on the use of any of the powerful facilities provided within the application, on-screen help is available at the click of a button.

Some key features:

- The applications are designed to use specification data when selecting piping components from the Catalogue database, so that design consistency and conformity to standards are ensured. It is important, therefore, that the Piping Catalogue databases are properly maintained: a Specification Generator facility is provided to enable this to be achieved with a minimum of effort.
- Piping elements may be named in accordance with a predefined set of rules, so that their positions in the database hierarchy are always obvious without you having to enter specific texts during the design process.
- Pointers may be set up to define the storage areas in which specific types of design element are to be held in the database hierarchy. This, especially when combined with the rule–based naming facility, minimises the amount of data which you have to enter explicitly as you build up your design model.
- Lists of elements may be set up temporarily, so that you can carry out a design operation on all elements within the list simultaneously. This can save you a great deal of repetitive work when carrying out commonly–repeated design modifications.
- The applications incorporate a number of geometric design aids, such as 3D positioning grids, design pins and 2D routing planes, to make it much easier to position piping elements accurately within the design model. In most cases you can specify the points at which design items are to be positioned simply by using the cursor to pick the required points in the displayed 3D model view(s).
- At any stage of your work, you can create reports listing specified data read from the current database. You can specify a standard report template, enabling you to derive lists of commonly required information extremely rapidly, or you can design a one–off report format to suit any special needs. The resulting output, which can include data from any design discipline, sorted in any way you require, can be either displayed on your screen or sent to a file (for storage and/or for printing).

Part II
Getting Started

3 Controlling PDMS

This chapter introduces the techniques for controlling PDMS using the graphical user interface which you will see on your screen. To do this, we will begin the tutorial exercise by entering PDMS and accessing that part of the program which you will use to specify your piping design data.

It is assumed that you are already logged in to your workstation and that you know enough about its operating system to enable you to run a program such as PDMS from an appropriate directory. It is also assumed that you know how to open and manipulate windows on your computer by using the mouse. If not, you first need to read the manuals supplied with your computer system or seek advice from your computer systems department.

In order for you to use the tutorial exercise, the equipment and pipework applications and the sample PDMS project (Project SAM) supplied must have been correctly installed and you must have been given read/write access to the project databases. This procedure, which should have been carried out by your PDMS administrator as part of the product installation sequence, is beyond the scope of this guide.

3.1 Accessing the Design Environment

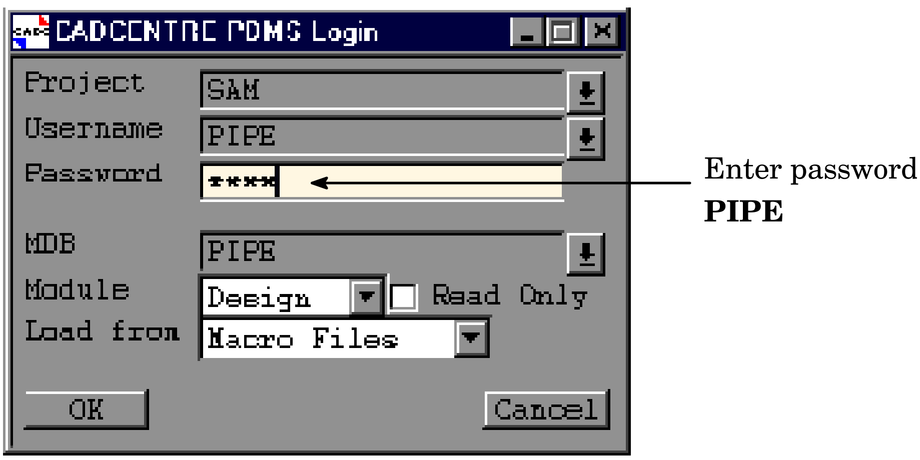
Exercise begins:

1. Start PDMS. The *CADCENTRE PDMS Login* form requires you to specify the following information for your intended session:

- The name of the **Project** in which you want to work. Enter **SAM**.
- Your allocated **User Name** and **Password**. Enter **PIPE** for each.
- The parts of the project database (i.e. which **Multiple Database** or **MDB**) you want to work in. Enter **PIPE**.
- The type of operation you want to carry out on the project data (i.e. which functional **Module** of PDMS you want to use). Select **Design**. (The **Read Only** button must remain Off, so that you can modify the database as you work.)
- Whether you want to start from the application's default settings (**Load from Macro Files**) or from a customised setup saved during an earlier session (**Load from Binary Files**). Select **Macro Files**.

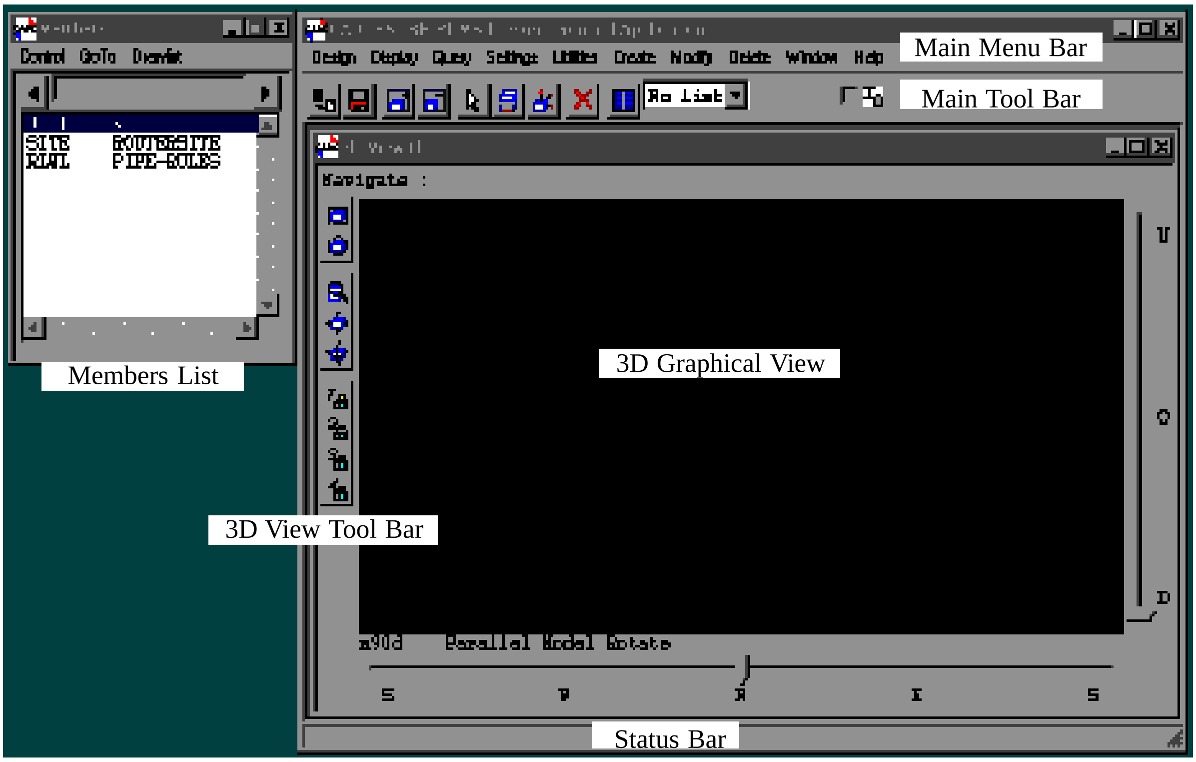
You can either type in each entry explicitly, or click the down arrow next to the text-box and select the required option from the resulting list.

The settings which you need to enter are as follows:



Click **OK** and wait while the application is loaded. The resulting windows will depend on your operating system:

NT Operating System:



- **Main Menu Bar** ¿
  commands. The title bar of this window shows the current PDMS module and its sub-application (if relevant) in which you are working; in this case, the *General* application of the *Design* module.

- **Main Tool bar** ¿
  operations and standard settings via icon buttons and drop-down lists.

- **Members List** ¿
  hierarchy. You can move to a different point in the database by using the left-hand mouse button to pick the required item in the list.

- **3D Graphical View** ¿
  design model graphically as it is being built up. Note that this window has a **pop-up menu**, selectable by using the *right-hand* mouse button, from which you will select options to control the ways in which the model is represented. It also has its own tool bar, the **3D View Tool Bar**.

- **Status Bar** ¿
  your operations. It is located across the bottom of the main window.

You can reposition or minimise these windows at any time by using the standard window management facilities provided by your workstation (but do *not* close them in this way).

3.2 Using the Mouse

You use the mouse to steer the graphics cursor around the screen and to select or 'pick' items by using the mouse buttons. The buttons perform different tasks depending on the type of window, and the position within the window, where the cursor is positioned. The appearance of the cursor will change according to the type of display item that is underneath it.

The functions of the buttons are:

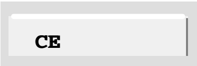
Left-Hand Button:
The left-hand button is the main button for selecting items. On a **graphical view**, clicking the left-hand button with the cursor over a design element results in that element becoming the **current element** (that is, the design item on which you want to carry out the next operation). In a sequence of **menus**, dragging with the left-hand button activates the command represented by the highlighted menu option when the button is released. On a **form**, the effect depends on the type of gadget that has been selected ¿

Middle Button:
The principal use of the middle mouse button in DESIGN is to manipulate a graphical view.

Right-Hand Button:
The principal use of the right-hand mouse button in DESIGN is to access the menu options specific to the graphical view window.

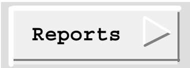
3.3 Using Menus

There can be three types of option in a pull-down or pop-up menu:



Options shown as plain text: selecting one of these initiates an action immediately.

Options followed by three dots: selecting one of these displays a form on which to select options, enter data, etc.



Options followed by a triangular pointer: selecting one of these displays a subsidiary menu giving a further range of options.

Throughout this guide, related selections from menus are shown in abbreviated form by using the **>** symbol as a separator. Thus, the sequence **Utilities>Reports>Create** means 'select **Utilities** from the main menu bar, then select **Reports** from the resulting pull–down menu, then move the cursor to the right and select **Create** from the resulting submenu'.

3.4 Using the Tool Bar Buttons

The tool bar is displayed immediately below the main menu bar in the application window. It contains a number of icon buttons which let you carry out common tasks without searching for the options in the menus.

The actions of the buttons are explained in the on–line help. If you pause the cursor over a button, a tool–tip pop–up will remind you of the function of the button. To activate a button, simply click on it.

NOTE: The tool bar can be switched off, or displayed with larger icons. To do so, select **Settings>System** from the main menu bar and then set the required options on the resulting *System Settings* form.

3.5 The Status Bar

The status bar displays messages telling you what actions the application is carrying out. You should look at it frequently, especially if the system appears to be waiting for you to do something, since it will always prompt you for any input or action which is required to carry out the next step of your current activity.

If the prompt lets you repeat a task an unspecified number of times, such as picking a selection of items using the cursor, you must press the **Escape** key (or click the **Escape** button on the *Status Form*) when you have finished to indicate that you are ready to move to the next operation.

3.6 Using Forms and their Controls

Forms are used both to display information and to let you enter new data. Forms typically comprise an arrangement of **buttons** of various types, **text-boxes**, and **scrollable lists**. Input to a form is usually via a combination of mouse and keyboard, the mouse being used to select appropriate controls and the keyboard to enter data.

While you have access to a form, you may change a setting, return to the initial values, accept and act on the current data, or cancel the form without applying any changes, according to the nature of the form.

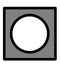
This section describes how to use the principal types of gadget that you will see on the various forms.

3.6.1 Using Radio Buttons

Radio buttons are used to select one, and only one, from a group of options. The selection is mutually exclusive, so that selecting one option deselects others in that group automatically.

They typically have the following appearance:

Radio button On 

Radio button Off 

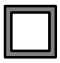
To change the selected radio button in a group, click the required button.

3.6.2 Using Check Boxes

Check boxes are used to switch an option between two states, typically On and Off. Unlike radio buttons, they do not interact, so that you can select any combination to be On at the same time.

They typically have the following appearance:

Check box On 

Check box Off 

3.6.3 Using Text-Boxes

Text–boxes are the areas where you type in alphanumeric data such as names or dimensions. A text–box will usually have a label to tell you what to enter.

When you first open a form which contains text–boxes, the first text–box on the form will be current and a text editing cursor (a vertical bar) will be displayed in the box. A text–box often contain a default entry (e.g. unset) when first displayed. Some text–boxes will accept only text or only numeric data, and entries with the wrong type of data will not be accepted.

To enter data into a text–box:

- Click in the box to insert the text editing cursor.
- Type in the required data, editing any existing entry as necessary. (You may need to delete the existing entry first.)
- When you have finished, confirm the entry by pressing the **Enter** (**Return**) key. Any text–box with an unconfirmed setting is highlighted by a yellow background.

3.6.4 Using Drop-Down Lists

Drop–down lists let you choose one option from a multiple selection. The list will usually have a label to tell you what you are setting and will show the current selection.

They typically have the following appearance:

NT Drop–Down List

To change the setting, click on the down arrow or button face to reveal the full list of available options, then pick the required option.

3.6.5 Using Scrollable Lists

A scrollable list is displayed as a vertical list of options within the form, with vertical and horizontal scroll bars along its sides. To select an option, click on the line you want. The selected line will be highlighted.

Some scrollable lists let you make only a **single selection**, so that selecting any option deselects all others automatically. Other lists let you make **multiple selections**, with all selected options highlighted simultaneously. To deselect a highlighted option in a multiple-choice list, click on it again (repeated clicks toggle a selection On and Off).

3.6.6 Actioning Form Inputs

Most forms include at least one **control button** which is used either to enter the command option represented by your current form setting, to cancel any changes made to the form since you opened it, or to close the form.

The common control buttons have the following actions:

Button	Action
OK	Enters the current form settings as command inputs and closes the form.
Apply	Enters the current form settings as command inputs and leaves the form displayed for further use.
Cancel	Cancels any changes made to the form's settings and closes the form.
Reset	Cancels any changes made to the form's settings and leaves the form displayed for further use.
Dismiss	Closes the form, keeping the current settings.

Some forms contain more specific types of control button which carry out particular command options (as indicated by the text on the button face; e.g. **Add** or **Remove**).

3.7 Alert Forms

Alert forms are used to display information such as error messages, prompts and requests for confirmation of changes. You should respond by carrying out the task prompted for or by clicking on the control buttons on the form (usually an **OK** or **Cancel** button).

3.8 Accessing On–Line Help

Most bar menus end with a **Help** option. Where available, on–line help gives detailed instructions on the use of the forms and menus via which you control each application.

The **Help** option gives you the following choices from its sub–menu:

Help>on Context

This gives you help on *any* window currently visible in the display. When you select this option, the cursor changes to a question mark (**?**). Move the question mark into the window on which you want help and click the left–hand mouse button.

Help>Contents

This displays the Help window so that you can find the required topic from the hierarchical contents list.

Help>Index

This displays the Help window so that you can find all topics relevant to a selected keyword.

Help>About

This displays information about the current operating system on your computer and about the versions of PDMS and its applications to which you have access.

Pressing the **F1** key at any time will display the help topic for the currently active window (equivalent to Help on Context for the current window).

Exercise continues:

2. Experiment with each of the **Help** options until you understand the search and navigation facilities for finding specific items of information. Use the **Help>on Context** option to read the help texts for any forms which you can currently see on your screen.

3. When you are ready to continue, close any forms which you have been experimenting with as follows:

- If a form has a **Dismiss** button, click this button.
- If a form has its own menu bar, select **Control>Close** from that menu.

- Close any *Help* windows which are displayed by double-clicking in the control box in the top left-hand corner of each window. Alternatively, select **File>Exit** from the *Help* window's menu bar.

Do *not* close the *Members List* or the *3D View* windows, as you will use these in the next parts of the exercise.

You are recommended to make full use of the on-line help facilities whenever you want clarification of any operations during the later steps of the exercise.

4 Setting Up the Database Hierarchy

Although this guide is about the design of piping networks, in practice you will usually need to route your pipe runs between predefined design points such as equipment nozzles. To show how this is done, we must consider how these other items are defined in PDMS as well as looking at how we connect sequences of piping components between them.

In this chapter we will look at the ways in which both equipment and piping design data are stored by PDMS and will create some administrative data elements which will enable us to organise our detailed design in a logical way.

4.1 How PDMS Stores Design Data

Before we start to create any detailed design data, it is important that you know how such data is stored and accessed in the PDMS databases, so that you will understand the terminology which you will encounter during the design process.

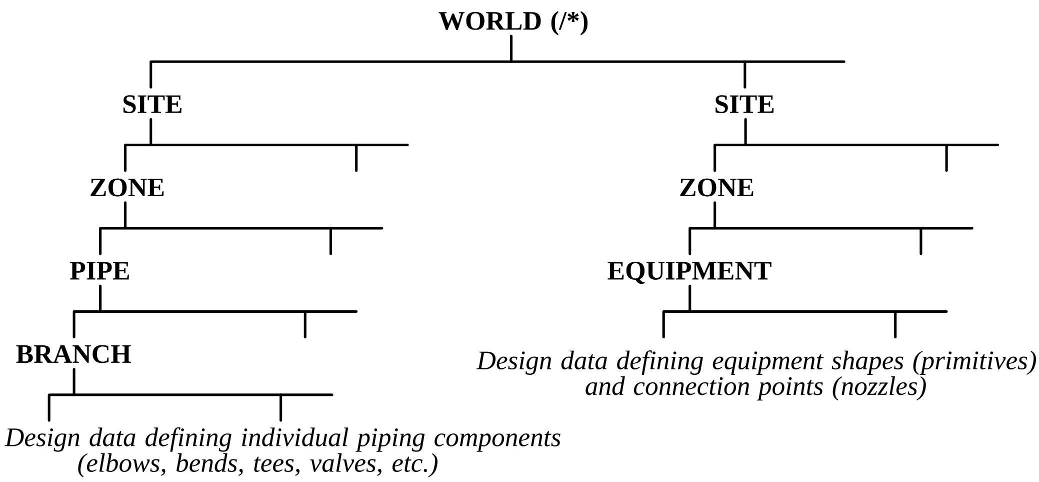
All PDMS data is stored in a hierarchic or ‘tree’ format (analogous to a filing room containing a number of cabinets, each of which contains several drawers, each of which contains a number of folders, each of which contains a set of individual data files). In the case of a PDMS Design database, the topmost data level is called the **World** (usually represented by the symbolic name /*), below which are the administrative sublevels **Site** and **Zone**.

The names used to identify database levels below Zone depend on the specific engineering discipline for which the data is used. In the case of piping design data, the lower administrative levels (and their PDMS abbreviations) are **Pipe** (**PIPE**) and **Branch** (**BRAN**). Each

Pipe can represent any portion of the overall piping network, but is usually used to group items with a common specification. Each Branch within a Pipe represents a single sequence of piping components running between two, and only two, points known as the **Branch Head** and the **Branch Tail**. The data which defines the physical design of the individual piping components is held below Branch level.

In its most basic configuration, equipment design data has only one administrative level below Zone, namely the **Equipment** (**EQUI**) level (the next chapter will introduce a slightly more advanced configuration). The data which defines the physical design of each equipment item is represented by a set of basic 3D shapes known as **Primitives** (Box, Cylinder, etc.) held below Equipment level, while connection points are represented by **Nozzles** (**NOZZ**).

Together, these hierarchic levels give the following overall format:



All data is represented in the database thus:

- Each identifiable item of data is known as a PDMS **element**.
- Each element has a number of associated pieces of information which, together, completely define its properties. These are known as its **attributes**.

  Every element is identified within the database structure by an automatically-allocated reference number and, optionally, by a user-specified name. Additional items of information about an element which could be stored as attribute settings include:

- Its type
- Its physical dimensions and technical specifications
- Its physical location and orientation in the design model
- Its connectivity

Some attribute settings must be defined by you when you create a new element, others will be defined automatically by PDMS.

The vertical link between two elements on adjacent levels of the database hierarchy is defined as an **owner-member** relationship. The element on the upper level is the **owner** of those elements directly linked below it. The lower level elements are **members** of their owning element. Each element can have many members, but it can have only one owner.

When you are modifying a database (for example, when you are creating new elements or changing the settings of their attributes), you can consider yourself to be positioned at a specific point within the hierarchy. The element at this location is called the **current element** (often abbreviated to **CE**).

You can navigate from any element to any other, thereby changing the current element, by following the owner–member links up and down the hierarchy.

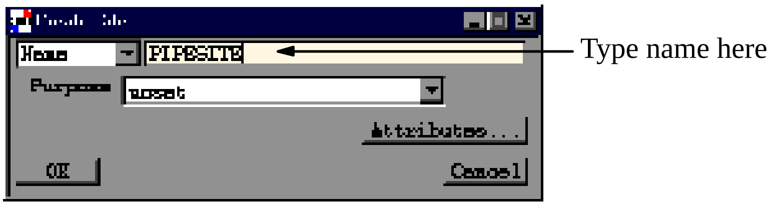
In many cases, commands which you give for modifying the attributes of an element will assume that the changes are to be applied to the current element unless you specify otherwise, so you must understand this concept and always be aware of your current position in the database hierarchy. The *Members List* (see Section 3.1) will always show you this information.

4.2 Creating Some Administrative Elements

We will now create some administrative elements at the top of the Design DB hierarchy, as explained in the preceding section.

Exercise continues:

4. Check that you are at World level (WORL) in the *Members List*, then select **Create>Site**. On the displayed *Create Site* form, enter the name **PIPESITE** in the Name text–box.



Press **Return** to confirm the name; note how the system adds a / prefix automatically to conform to PDMS naming conventions. Click **OK** to create the Site element. Notice that the new element appears in the *Members List* as the current element.

5. Repeat this process, using the **Zone** option on the **Create** menu, to create *two* Zones named **PIPEZONE** and **EQUIZONE** (in which we will store piping data and equipment data, respectively), both owned by PIPESITE.

Your *Members List* should now look something like this:

(If you or other users have accessed this database before, the list may contain other elements as well.)

In the next chapter we will create some standard equipment items, to give some reference points between which we can subsequently route our sample piping sequences.

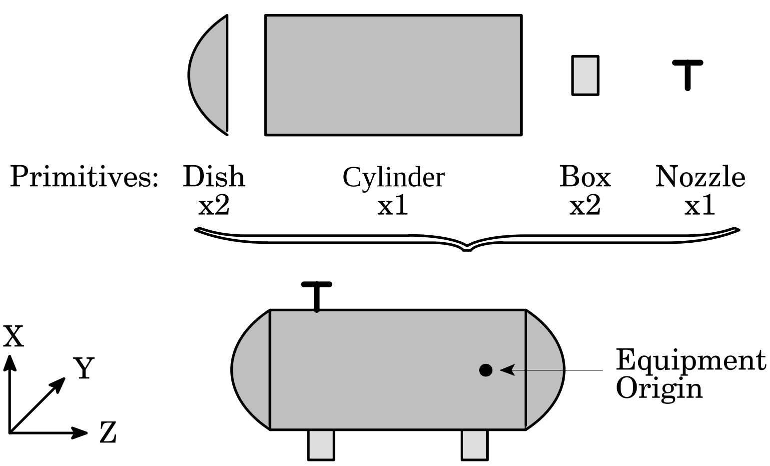
5 Creating Some Equipment Items

In this chapter we will create some simple equipment items, to predefined designs, which will form the basis for routing our piping network.

5.1 How Equipment Items are Represented

5.1.1 The Basic Principles

Each item of equipment is defined geometrically in PDMS as a collection of basic 3D shapes known as **primitives**. Piping connections to equipment items are represented by **nozzles** (which are standard components which you select from the PDMS catalogues). For example, a simple storage vessel might be built up from a cylinder for the main body, two dishes for the ends, two boxes for the support legs and a nozzle for the piping connection, like this:



The **position** of the equipment item as a whole, and the relative positions of its component primitives, are specified in terms of its

origin. The **orientation** of the equipment item is specified by aligning the X,Y,Z axes of its primitives within the E,N,U (East, North, Up) coordinate system of the design model (more accurately, the E,N,U coordinate system of the item's owning Zone).

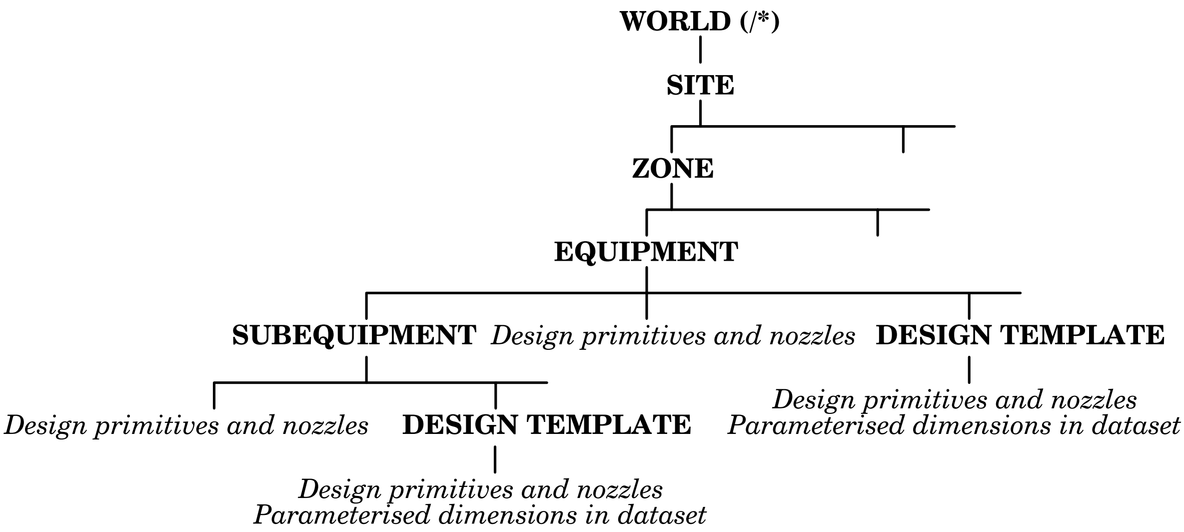
(We will look in more detail at the principles of positioning and orientating items within the PDMS design model when we start to create piping components.)

5.1.2 Using Predefined Templates for Standard Equipment

To save you having to build up each item of equipment from its component primitives, the application lets you select from a range of predefined equipment types. These standard equipment types, some of which will have been supplied with the original application and some of which may have been added within your company, are stored as **parameterised Design Templates (TMPL)**. The master copies of these design templates are stored in a special part of the design database. When you select one of these for inclusion in your design, a copy of the design template is created below the parent equipment element; all primitives defining the template geometry are stored below this template copy. Any variable dimensions etc. needed to fully specify the equipment in the design are stored as **Design Data (DDAT)** elements below a **Design Dataset (DDSE)** owned by the template; these are jointly referred to as the design element's **properties**.

NOTE: For the purposes of the current exercise, you do not need to fully understand all of the implications of this alternative method of storing design data. The concepts are introduced here simply so that you will be able to recognise some of the new elements which will be added into your *Members List* as you progress through the steps of the exercise.

To enable a template designer to reuse standard configurations of primitives within an equipment design, the Equipment element may sometimes be subdivided into **Subequipment (SUBE)** elements, giving the following possible extended hierarchy (compare this with the simple version shown in Section 4.1):

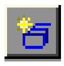


5.2 Creating a Storage Tank to a Standard Design

Exercise continues:

6. To start the Equipment application, select **Design>Equipment** from the *Design General Application* menu bar. When loading is complete, the main menu bar and the tool bar (which now has a second row) will show some extra options, thus:

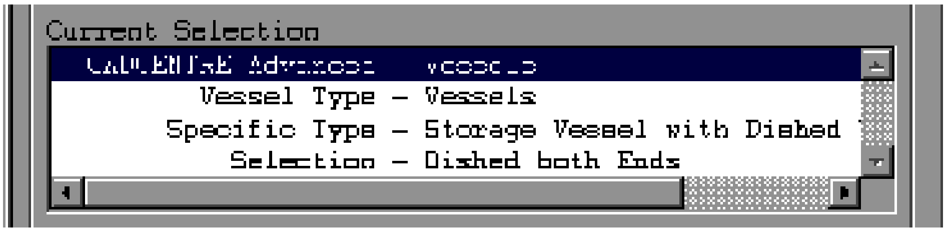
which give you access to the whole range of functions needed to create and position equipment items. We need only a few of these options for our current purpose.

7. We will first create a storage tank by selecting a standard design which is supplied as part of the application. Check that your current element is the zone which you created for storing equipment items (/EQUIZONE) and then either select **Create> Standard** from the menu bar or click the  button in the second row of the tool bar. You will see a *Create Standard Equipment* form which lets you choose the required item.

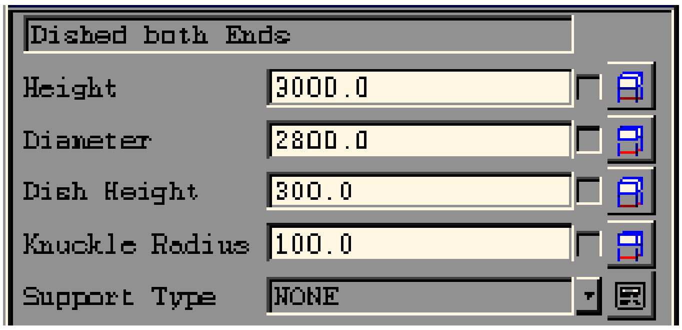
Enter the equipment **Name** as **Tank-1**.

The **Specification Data** area of the form lets you narrow down your choice of standard equipment by a progressive ‘question and answer’ sequence. At each stage of the search, you select from the options in the lower list (whose title changes to reflect its content) and the progress of the search is summarised in the **Current Selection** list.

From the **Specification** drop-down list, select **CADC Advanced Equip(ment)** and from the **CADCENTRE Advanced** list select **Vessels**. Notice how this selection is copied to the **Current Selection** list, while the lower list now shows three **Vessel Type** options. Select **Vertical Vessels**, then select **Storage Vessel with Dished Top & Bottom**, then select **VESS 001 - Dished both Ends**. Note that the lower list title now says **Selection complete** and that this list is now empty. The **Current Selection** list shows the fully-specified equipment, thus:



If we create the equipment at this stage, it will be given default dimensions defined by the template designer. We will specify our own dimensions, so click the **Properties** button to display a *Modify Properties* form listing all parameterised dimensions assigned to the equipment definition. Set these as follows: **Height**: **3000**; **Diameter**: **2800**; **Dish Height**: **300**; **Knuckle Radius**: **100**. Select **Support type**: **NONE**.

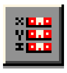


The dimensioned plot view in the lower part of the *Modify Properties* form shows the significance of the dimensions.

NOTE: If you cannot see the plot view, select **Settings> Properties** from the main menu bar and set **Display Plotfile** to On on the resulting *Properties Settings* form. Close and then redisplay the *Modify Properties* form to show the plot view.
Alternatively, click the **Plotfile** button on the *Create Standard Equipment* form or *Modify Properties* form to display the plot in a separate window at any time.

To zoom in so that you can read the text, position the cursor in the plot area, hold down the *middle* mouse button, drag out a rectangle enclosing the region of interest, and release the button. To zoom out, position the cursor over the centre of interest of the plot and click the middle mouse button.

OK the *Modify Properties* form, then **Apply** the *Create Standard Equipment* form.

8. At this stage, before the equipment can be added into the database, you must specify its position. In a normal design situation, you would position it relative to part of an existing plant structure. The *Positioning Control* form, which has now appeared, provides various ways of picking a position in the graphical view. In our case, this view is empty, so we cannot pick any existing reference point; we will, instead, enter an explicit position which will suit the remainder of the exercise. To do this, click the  button on the *Positioning Control* form to display an *Explicit Position* form. On the latter, enter the coordinates **E**ast **7275**; **N**orth **2350**; **U**p **100** and click the **Apply** button.

The tank will be added into the *3D View*, but the current view settings probably mean that you will not be able to see it properly. We will rectify this a little later. Notice how the *Members List* now shows an Equipment (EQUI) element, which owns a Design Template (TMPL), which in turn owns some primitives and property–defining elements representing the equipment's geometry (as summarised in Section 5.1.2).

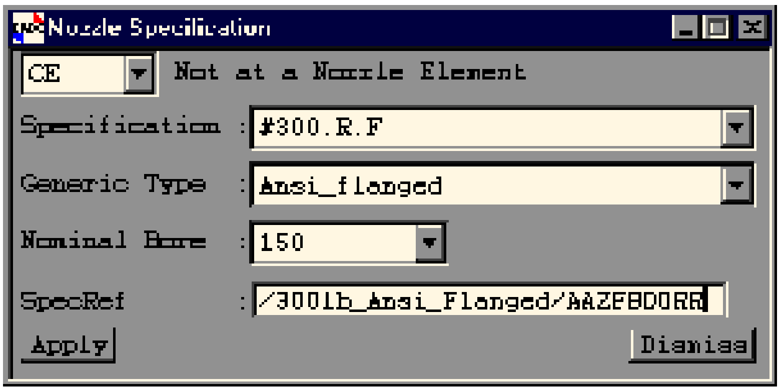
Dismiss the *Create Standard Equipment* form.

9. This standard vessel design does not incorporate any nozzles, so we need to add one so that we can later connect our pipework to it. To do so, select **Create>Primitives** and set the resulting form as follows:

Click **Apply** to display a *Create Nozzle* form and, on the latter, enter the following data:

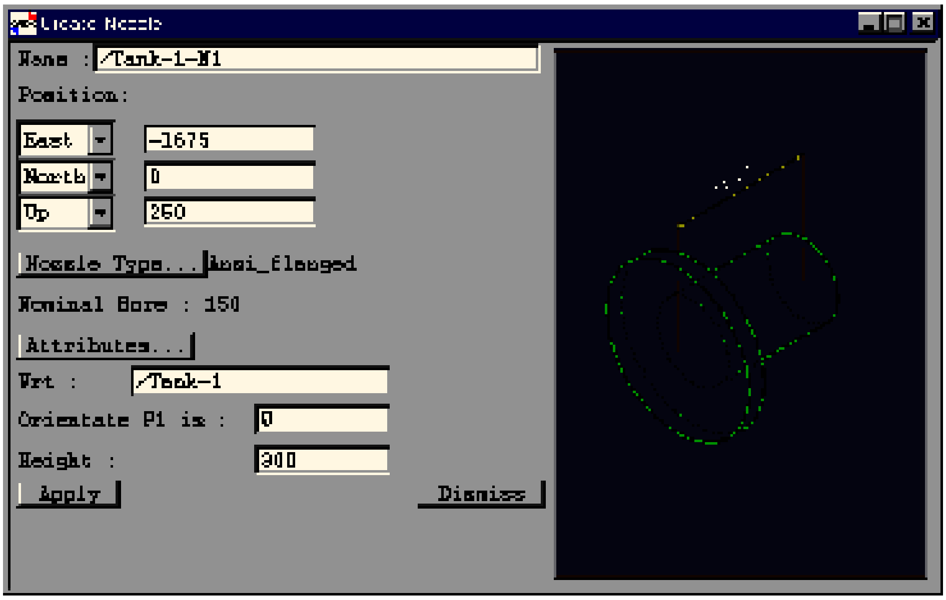
- **Name**: **Tank-1-N1**
- **Position**: **East ¿** (or **West 1675**); **North 0**; **Up 250**
- **Orientate P1 is**: **W** (sets the direction of the nozzle's flanged face)
- **Height**: **300** (the 'height' of a nozzle is the length of its connecting tube)

10. To define the nozzle type, click the **Nozzle Type** button. You will see a *Nozzle Specification* form from which you can select any type of nozzle available in the project catalogue. Select the following options: **Specification #300.R.F**; **Generic Type Ansi_Flanged**; **Nominal Bore 150**. Click **Apply**:



(We will see in more detail how catalogues are used when we start to select piping components.)

11. The settings on the *Create Nozzle* form should now look like this:



Click **Apply** and then, if you have not already done so, **Dismiss** all forms involved in nozzle creation.

5.3 Viewing the Design

In order to see what our design looks like as we build it up, and to enable us to identify design items by simply pointing to them rather than by navigating to them in the *Members List*, we will now display our current design in a *3D View* window and learn how to manipulate this display.

5.3.1 Defining What Appears in the View

Exercise continues:

12. Select either **Display>Drawlist** from the main menu bar or **Control>Drawlist** from the *Members List* menu bar. The normal *Members List* will be replaced by an extended version entitled *Members+Draw*. This lets you build up a list of all elements which you want to display, as shown in the **Drawlist** scrollable list in the lower part of the form. If this list already contains entries (it should the Equipment /Tank–1 and the unnamed Template), click the **All** button in the **Remove From Drawlist** section to empty the list (the view should now show no design elements).

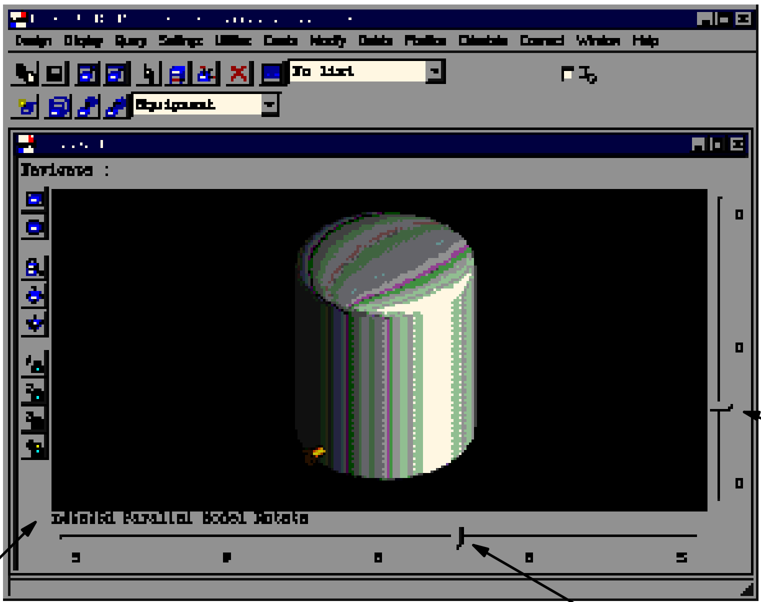
We want to see all of the equipment items as we create them, so navigate to EQUIZONE by clicking on it in the upper list and click the **Add CE** button in the **Add To Drawlist** section to put the whole Zone into the **Drawlist**.

Select **Control>Close** from the menu on the *Members+Draw* form to remove the form from the screen and replace it by the normal *Members List*.

13. Position the cursor in the *3D View* window and hold down the right–hand mouse button to display the pop–up menu. Select **Limits>CE** (CE means Current Element). This adjusts the scale of the view automatically such that it corresponds to a volume just large enough to hold the chosen element(s); in this case, the Zone.

14. Again using the *3D View* menu, select **Iso>Three** to set an isometric view direction.

You should now see the vessel /Tank–1, something like this:



NOTE: If the horizontal and vertical sliders are not visible, select **Settings>Borders** from the *3D View* menu to display them.

15. Observe the effect of selecting different view directions from the **Look** and **Iso** menu options. Revert to **Iso>Three** when you have finished.

5.3.2 Manipulating the Displayed View

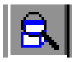
You can manipulate the displayed model view in a number of ways. The three basic operations which we will look at here are:

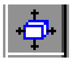
- Rotate the view
- Pan the view across the display area
- Zoom in or out to magnify or reduce the view

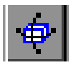
The current manipulation mode is shown in the status line at the bottom of the *3D View* window (it is set to Rotate in the preceding illustration).

To change the view manipulation mode, look at the **View Control** options on the pop-up menu. The options of interest are **Zoom**, **Pan** and **Rotate**.

Alternatively, you can change the manipulation mode by pressing one of the function keys, or by using the *3D View* tool bar buttons, thus:

F2 or  selects **Zoom** mode

F3 or  selects **Pan** mode

F5 or  selects **Rotate** mode

Exercise continues:

16. Select **Rotate** mode. Position the cursor in the view area and hold down the middle mouse button, then move the mouse slowly from side to side while watching the effect on the displayed model. The initial direction of movement determines how the view appears to rotate; starting with a left or right movement causes the observer's eye–point to move across the view. Now release the mouse button, hold it down again and move the mouse away from you and towards you; this time the observer's eye–point should appear to rotate up and down around the model.

Repeat the rotation operations while holding down the **Control** key. Note that the word Fast appears in the status line and that the rate of rotation is increased. Now repeat the same actions, but this time hold down the **Shift** key. Note that the word Slow appears in the status line and that the rate of rotation is decreased.

For an alternative way of rotating the model, try dragging the horizontal and vertical sliders to new positions along the view borders. You can rotate the model in this way at any time, regardless of the current manipulation mode.

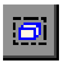
17. Select **Pan** mode. Position the cursor in the view area and hold down the middle mouse button, then move the mouse slowly in all directions. Note that it is the observer's eye–point which follows the mouse movement (while the viewing direction remains unchanged), so that the displayed model appears to move in the opposite direction to the mouse; in effect, you move the mouse towards that part of the view which you want to see.

Repeat the pan operations while holding down first the **Control** key (to increase the panning speed) and then the **Shift** key (to decrease the panning speed).

18. Select **Zoom** mode. Position the cursor in the view area and hold down the middle mouse button, then move the mouse slowly up and down. Moving the mouse away from you (up) zooms in, effectively magnifying the view; moving the mouse towards you (down) zooms out, effectively reducing the view. Note that these operations work by changing the viewing angle (like changing the focal length of a camera lens); they do not change the observer's eye–point or the view direction.

Repeat the zoom operations while holding down first the **Control** key and then the **Shift** key.

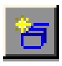
19. Position the cursor at the top of the tank and click (do *not* hold down) the middle mouse button. Notice how the view changes so that the picked point is now at the centre of the view. Whenever you click the middle button, whatever the current manipulation mode, you reset the **centre of interest**. Switch to **Zoom** mode (if not already selected), set the centre of interest to the face of the nozzle, then zoom in for a close–up view. You will find this a very useful technique when making small adjustments to the design.

20. To restore the original view when you have finished, check that your current element is /EQUIZONE and reselect **ISO>Three** and **Limits>CE**. (A shortcut for the latter operation is to click the  button in the *3D View* tool bar.)

5.4 Creating Some More Equipment Items

So that we have several equipment items between which to route piping components, we will now create a different design of vertical storage vessel and a pump, using similar procedures to that which we used to create the first vessel.

Exercise continues:

21. Navigate to /EQUIZONE and select **Create>Standard** or click the  button, as in Step 7. Name the equipment /**Tank-2** and, from **Specification**: **CADC Advanced Equip**, select **CADCENTRE Advanced: Vessels**, **Vessel Type**: **Vertical Vessels**; **Specific Type**: **Storage Hoppers**; **Selection**: **VESS002 - Dished Top and Coned Bottom**.

Click the **Properties** button and set the properties as follows: **Height**: **2500**; **Diameter**: **1500**; **Dish Height**: **250**; **Knuckle Radius**: **75**; **Cone Height**: **750**.

This design includes provision for one nozzle at the bottom of the conical base. Set **Nozzle Height** to **250** and, from the **Nozzle Type** options, select **#300.R.F. 150mm NS** (this is the same as the nozzle on Tank-1).

Select **Support type**: **NONE**.

22. Position the equipment at **East 2600**; **North 7000**; **Up 2600** (as in Step 8).

23. Observe the relative positions and orientations of the two vessels in the graphical view. You will need to reset the limits, since /EQUIZONE is now larger than when you last set the viewing scale.

24. We will name the nozzle in the base of the new vessel, so that we can refer to it in later steps of the exercise. To do so, navigate to the nozzle (which is owned by the template, which is owned by the equipment). The option gadget in the second row of the main tool bar controls the hierarchic level to which you navigate when you pick items in the *3D View*. By default, it is set to **Equipment**; if you try to pick the nozzle with this setting you will navigate to its parent equipment. Change this option to **Element**, thus:

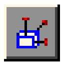
and then pick the nozzle. Select **Modify>Name** and name the nozzle /**Tank-2-N1**.

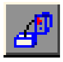
25. Navigate back to /Tank–2 and add a second nozzle using the same sequence as in Steps 9 to 11. Name this nozzle /**Tank-2-N2**; position it at **East 1000**, **North 0**, **Up 2000**; orientate its flange to point **East**; and set its height to **250**. Select the specification **#300.R.F.**; **Ansi-flanged**; **100 Nominal Bore** (note that this has a smaller bore than the other nozzles). You may also need to rotate the view to see all of the nozzles simultaneously.

26. We will now create a standard design of pump. Display the *Create Standard Equipment* form. Name the equipment /**Pump-1** and, from **Specification**: **CADC Advanced Equip** select **CADCENTRE Advanced Pumps**, **Pump Type**: **Centrifugal Pumps**; **Specific Type**: **Centreline Mounted Centrifugal Pumps; Selection**: **PUMP 005 - Pump Centreline Mounted Tangential Outlet**.

Set the properties as follows: **Baseplate Length**: **1600**; **Baseplate Width**: **510**; **Distance Origin to Baseplate**: **175**; **Distance to Suction Nozzle**: **240**; **Distance Bottom to Centreline**: **340**; **Discharge Nozzle Height**: **180**; **Suction Nozzle to Coupling**: **700**; **Distance Discharge Nozzle**: **135**; **Suction Nozzle Type**: **#300.R.F. 150mm NS**; **Discharge Nozzle Type**: **#300.R.F. 150mm NS**.

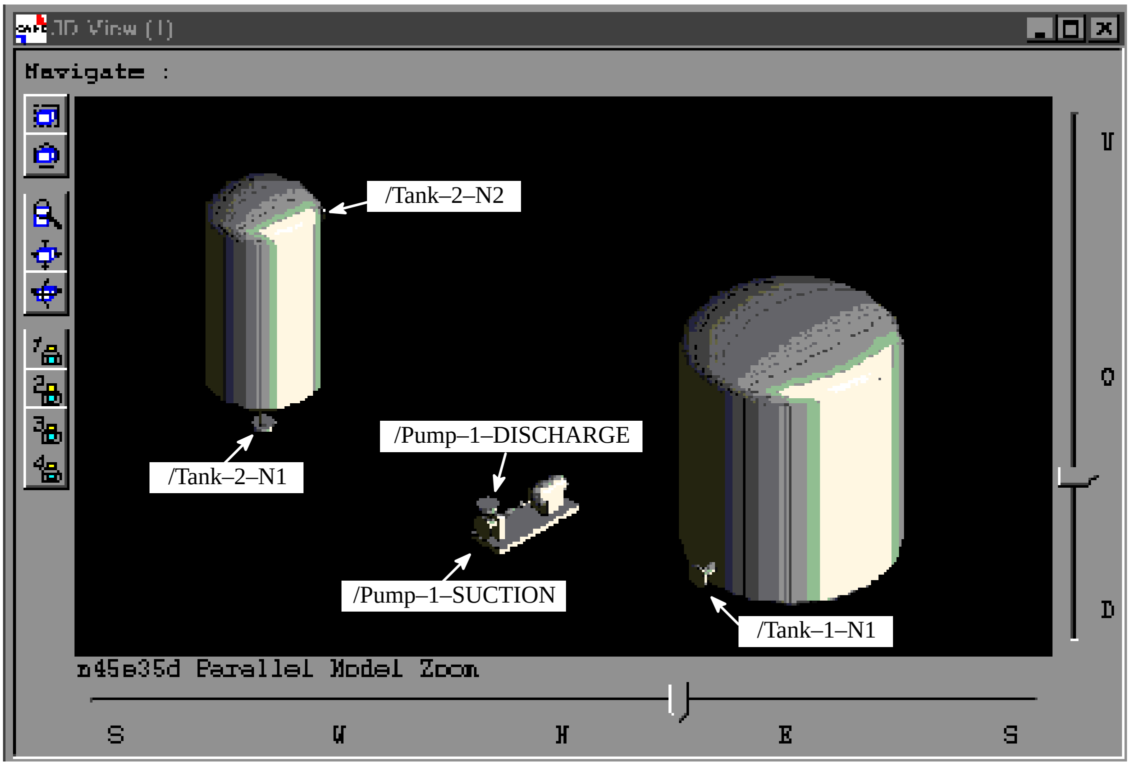
Create the pump and position it at **East 4700**; **North 5000**; **Up 350**.

27. The pump's orientation is as defined by the template's default settings. To check the current orientation, click the  button on the main tool bar to display the *Define Axes* form. On the latter, set the **Cardinal Directions** button **On** to display an **E,N,U** axes symbol at the origin of the current element. You will see that the horizontal suction nozzle points North: we want it to point West.

To change the orientation, either select **Orientate>Rotate** from the menu or click the  button on the tool bar. The *Rotate* form lets you rotate the equipment through a specified angle about a defined axis. The default axis (Up, through the origin) is correct, so just set **Angle** to **90** and click **Apply**. Dismiss the *Rotate* form and select **Close>Retain axes** on the *Define Axes* form. This leaves the axes symbol in the *3D View*: you will find this useful for reference in the rest of the exercise.

28. Navigate to each pump nozzle in turn and name the horizontal nozzle /**Pump-1-SUCTION** and name the vertical nozzle /**Pump-1-DISCHARGE** (as in Step 24).

29. Check the layout of the three equipment items in the graphical view. The equipment zone should now look like this:



(The nozzles, which are the only parts of the equipment of interest to us for piping design purposes, are labelled in the above illustration for reference.)

5.5 Saving Your Changes and Leaving Your Design Session

30. To update the database so as to store the design model which you have created so far, select **Design>Save Work** from the main menu bar or click the  button. (It is wise to use this function periodically as you build up a design, so that you do not have to start from the beginning in the event of loss of work due to an unforeseen interruption, such as a power failure.)

31. To save your current screen layout and display settings, so that next time you use the application you can rapidly restart from where you interrupted your design session, select **Display> Save>Forms & Display** from the main menu bar.

32. To leave your current PDMS design session and return to the operating system, select **Design>Exit** from the main menu bar. If you had made any changes since your last **Save Work** operation, you would be asked if you wanted to save them; in the present situation, you will just be asked to confirm that you want to leave PDMS.

In the next chapter, we will add to the design model by creating some piping components.

6 Routing a Sequence of Piping Components

In this chapter we will route some pipes between the three items of equipment which currently make up our design model, positioning a selection of piping components within the pipe runs. Before we do so, it is important to understand how some of the items which make up the design are represented and accessed in the PDMS databases, as explained in the following sections.

6.1 Design–to–Catalogue Cross–Referencing

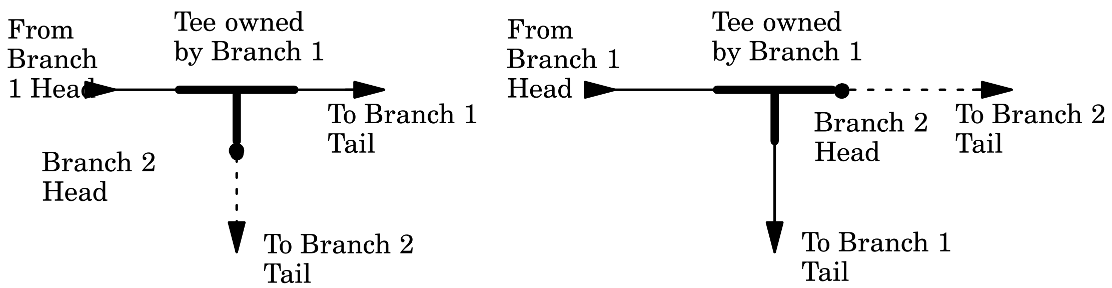
To ensure design consistency and conformity with company standards, the basic definitions of all items which you may use in the pipework design are held in a **Catalogue** database. This holds definitions of all available configurations and materials for each type of piping component, and all types of nozzle for connecting pipe fittings to equipment items. When you add an item to your design model, you store the position, orientation etc. for the item in the Design database, but you specify the physical properties of the item by setting up a *cross-reference* (called a **Specification Reference** or **SpecRef**) which points to an appropriate entry in the Catalogue database. The dimensions of each item are defined in the catalogue by parameters whose values are set only at the design stage, so that a single catalogue entry can represent a whole family of design components which differ only in their dimensions.

We have already used this concept when creating the equipment nozzles in Chapter 5. In each case, we selected the required type of nozzle by setting its catalogue specification (for example: ANSI flanged, with raised face, suitable for 300 pound working pressure, with 150 mm nominal bore), and we specified the length of the nozzle tube (defined in the catalogue as a parameterised dimension) by setting its Height attribute.

6.2 How Piping Networks are Represented

6.2.1 Pipes and Branches

To remind you of that part of the Design database hierarchy used to store pipework designs (as illustrated in Section 4.1), the principal administrative elements are **Pipes** and their subordinate **Branches**. Each Pipe can represent any portion of the overall piping network, while each Branch represents a single section of a Pipe which runs between two, and only two, points (called the **Branch Head** and the **Branch Tail**). The individual piping components (defined in terms of their catalogue specifications, as explained in Section 6.1) are stored as Branch members. Thus a Pipe which incorporates a Tee, for example, must own at least two Branches to achieve the necessary three connection points. The following configurations show two ways of achieving this (solid lines represent part of Branch 1; dotted lines represent part of Branch 2):



6.2.2 Piping Components

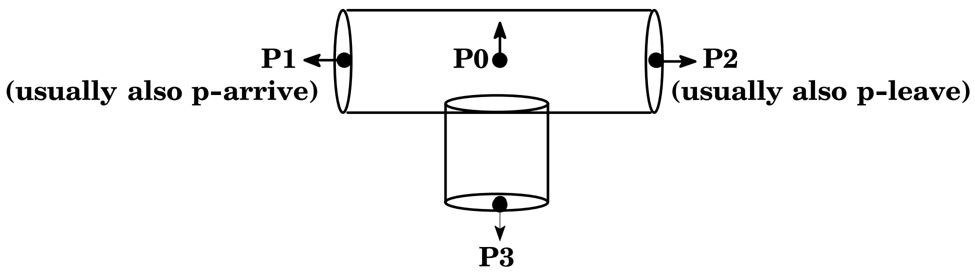
Each piping component is represented in the PDMS catalogue by three types of data:

- The physical shape of the component is defined by a set of geometric **primitives** (like the ones used to represent equipment items, which were introduced in Section 5.1).
- In order that the component can be manipulated and linked to adjacent piping items, all principal points needed to define its

position, orientation and connectivity are identified by uniquely-numbered 'tags'. These tags, which have both position and direction, are called **p-points**. Each p-point is identified by a number of the format **P0**, **P1**, **P2** etc., while the principal inlet and outlet points for the logical flow direction through the component are also identified as **p-arrive** and **p-leave**. P0 always represents the component's origin position, while in normal pipe routing mode ('forwards' mode) P1 is the same as p-arrive and P2 is the same as p-leave.

- The settings of all variables needed to distinguish a component from others with the same geometry and p-point sets are defined by **parameters**. The values of these are defined to suit the specific design requirements.

For example, a Tee component might be represented in the PDMS catalogue as follows:



where the two cylinder primitives form the component's **geometry set** and the four p-points form its **point set** (the fourth p-point, P3, lets you specify the orientation of the side arm when you incorporate the tee into your design). The dimensions of the tee are represented in the catalogue by parameters whose values are determined by the nominal bore required to suit the design.

6.3 Restoring Your PDMS Session and Starting the Pipework Application

Exercise continues:

33. Restart PDMS and enter the Design module (as in Step 1), but this time set the **Load from** option on the *PDMS Login* form to **User's Binary**. When loading is complete, your screen should look the same as it did when you saved the layout in Step 31.

(If you intend to continue from where you finish at the end of any PDMS session, it is always quicker to use the **Display> Save>Forms & Display** option so that you can reload the binary files in this way, rather than to reload the applications from their source macros each time you use the Design module. You can revert to the most recently saved layout at any time by selecting **Display>Restore>Forms & Display**.)

34. To change from the current Equipment application to the Pipework application, select **Design>Pipework**. The menu bar for the Equipment application will be replaced by that for the Pipework application. Although superficially similar, the latter will now give you access to those options relevant to creating and manipulating piping components.

You will also see a *Default Specifications* form, shown automatically, whose purpose we will now consider.

6.4 Setting a Default Specification

When you select components from the piping catalogue (see section 6.1), you will do so by stating which **specification** the components must match. To save you having to respecify this data for each component, you can set a **default specification** at Pipe or Branch level which will be used automatically at lower levels unless you override it (the default specification is said to be 'cascaded' down the hierarchy).

As an example, the specifications which form part of the sample project within which you are working include:

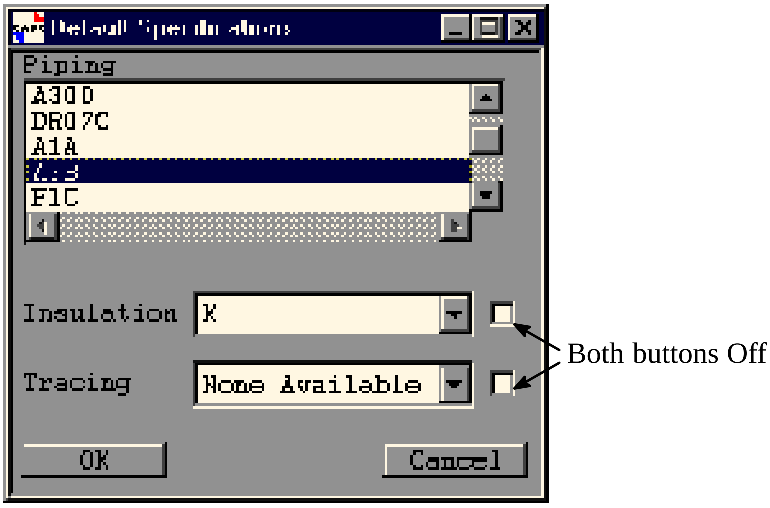
A1A ANSI Class 150 Carbon Steel
A3B ANSI Class 300 Carbon Steel
F1C ANSI Class 150 Stainless Steel

For the purposes of our design exercise, we will use the A3B specification to select all components.

Exercise continues:

35. On the *Default Specifications* form, select the **Piping** specification **A3B**.

The project specifications include some choices for pipework insulation (as shown by the **Insulation** option button), but no trace heating specifications (as shown by the **None Available** entry on the **Tracing** option button). We do not want to use insulation or trace heating, so check that both of these have their toggle button set to Off, like this:

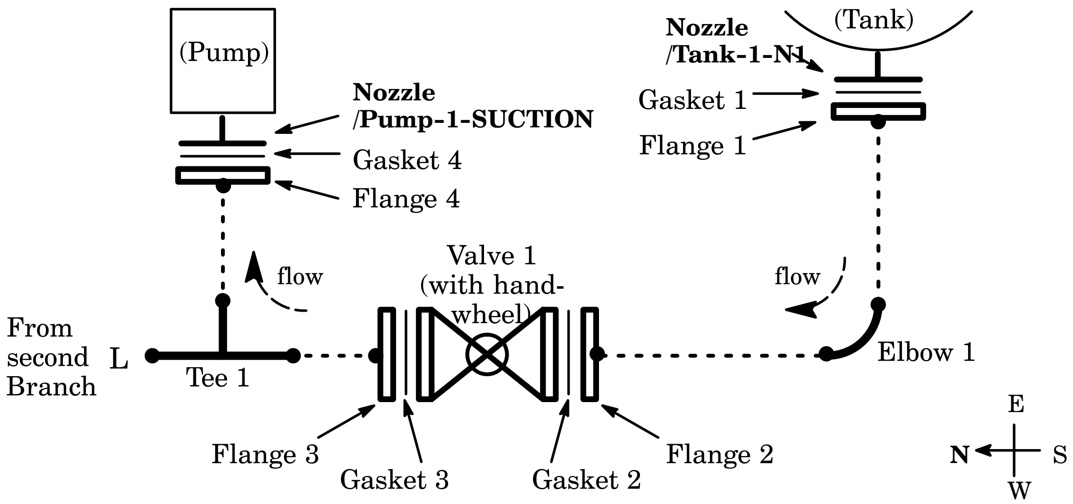


When you click **OK**, the current default specification will be shown in the second row of the tool bar, thus:

6.5 Creating a Simple Pipework Sequence

In the next part of the exercise we will create a sequence of piping components connected between the nozzles /**Tank-1-N1** and /**Pump-1-SUCTION** (see illustration in Step 29 or, preferably, use the *Members List* and *3D View* to see where these are). The initial sequence will include a tee to which another pipework sequence will be connected later.

The configuration which we will create (with all components in a horizontal plane) is as follows:



We will represent both this and the next sequence by a single **Pipe** element in the design database, but we must subdivide this into *two* **Branch** elements to allow the flows into the pump to combine at the tee. We will define the branches as follows:

- **Branch 1** will have its **Head** at Nozzle /Tank1–1–N1 and its **Tail** at Nozzle /Pump–1–SUCTION. It will consist of the following components, listed in head–to–tail order: **Gasket 1**, **Flange 1**, **Elbow 1**, **Flange 2**, **Gasket 2**, **Valve 1** (which includes flanges in its catalogue definition), **Gasket 3**, **Flange 3**, **Tee 1**, **Flange 4**, and **Gasket 4**. Note that the flow through the tee will enter at P1 and leave at P3 (that is, p–arrive will be P1 and p–leave will be P3).
- **Branch 2**, which we will create in a later part of the exercise, will have its **Head** positioned at Nozzle /Tank–2/N1 and its **Tail** at the third arm of the tee (P2), marked ★ in the diagram (remember that flow direction is always from head to tail).

NOTE: The **tubing** which runs between the piping items, shown by the dotted lines in the diagram, is added and adjusted automatically by PDMS to suit the positions and specifications of the components. You do not have to create it explicity; it is referred to as **implied tube**.

Refer back to the sequence in the diagram when necessary to understand the logic of the following steps for creating this in the design model.

Exercise continues:

36. Navigate to the zone which you created for storing piping items (/PIPEZONE) and select **Create>Pipe**. Note that the *Create Pipe* form automatically shows the default specification A3B and any insulation/tracing settings in force.

For interest, click the **Attributes** button to see the types of optional information which you can associate with a pipe definition in the database. We will not explain these in detail here, although most of them should be self–explanatory. You will see that you can specify most of the data needed to fully define a piping network ready for construction and erection; this data will then be cascaded down to all lower levels as you create the piping components. We will leave all detailing attributes at their default settings, so **Cancel** the form when you have looked at it.

Name the pipe **Pipe–1** and **OK** its creation.

NOTE: It is assumed from now on that you know how to use the **OK**, **Apply**, **Cancel** and **Dismiss** buttons on forms, so they will not always be mentioned in the rest of the exercise.

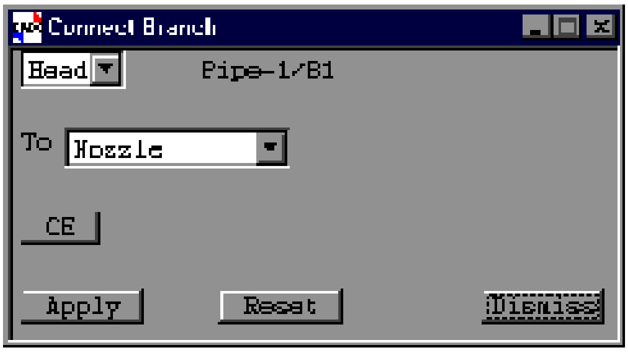
37. As you have just created an 'empty' pipe, a *Create Branch* form will be shown automatically (otherwise you would need to select **Create>Branch** to see the form). Note how the new branch is named automatically from its owning pipe as **Pipe–1/B1**.

You can specify the **Head/Tail Setting** in one of three ways:

- **Connect** lets you position the head/tail at a specified nozzle, piping component or other branch head/tail and automatically sets up a logical connection reference between them.
- **Explicit** lets you position the head/tail at specified coordinates.
- **None** leaves the head/tail position undefined (default is the origin of the owning zone).

We want to connect both head and tail of the branch to existing nozzles, so set the option to **Connect**. When you **OK** the branch creation, you will see a *Connect Branch* form which lets you specify how the head and tail are to be connected.

Set the *Connect Branch* form to show that you want to connect the **Head** to a **Nozzle**, thus:



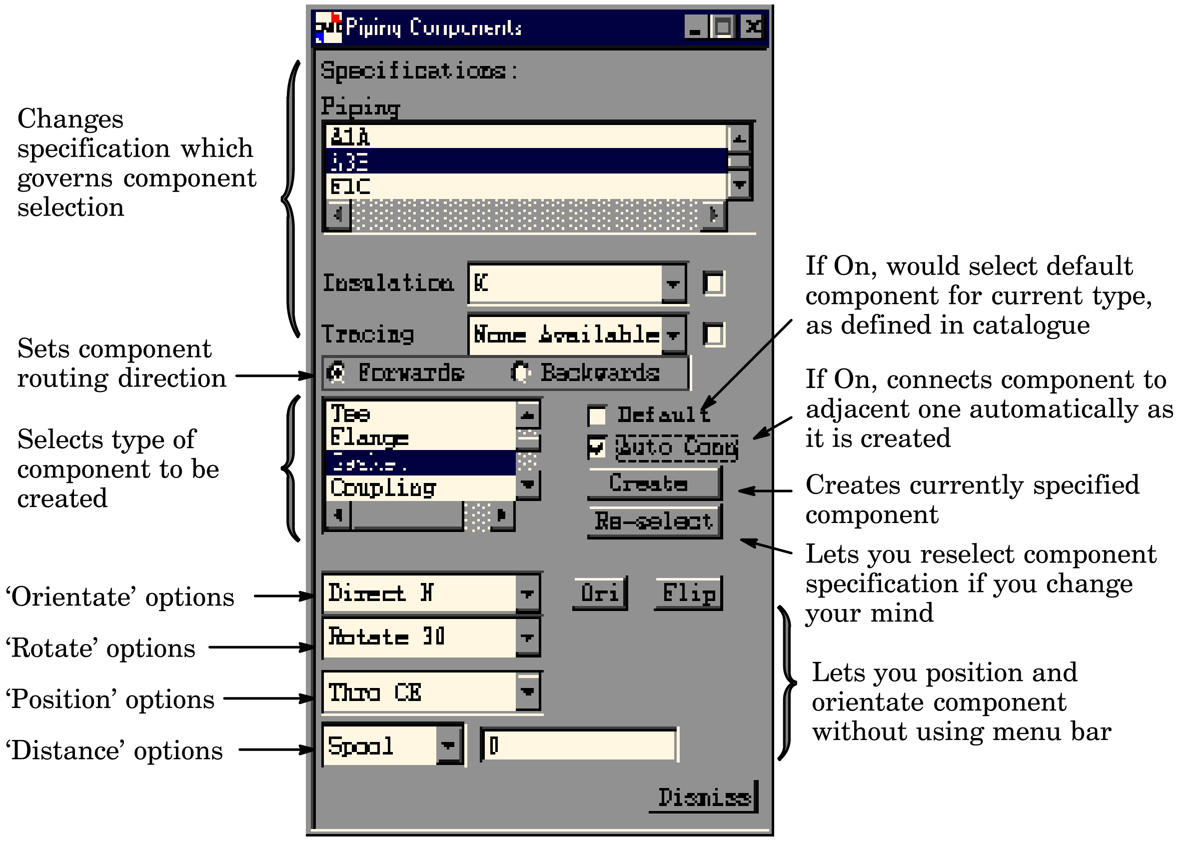
When you click **Apply** you will be prompted to identify a nozzle (the status bar will say ‘Identify NOZZ’). Pick /Tank-1-N1 (i.e. the nozzle on the larger tank) in the graphical view.

Repeat this procedure to connect the branch tail to the nozzle /Pump-1-SUCTION (i.e. the horizontal nozzle on the pump).

Notice how the route of the branch is shown in the graphical view by a broken line. As we have not yet introduced any components, this runs directly from the head to the tail.

38. We will now build up the component sequence by creating individual piping items.

Select **Create>Components**. You will see a *Piping Components* form from which you can control all operations for specifying a pipe run. As well as letting you select the type of component required, this form includes gadgets which let you access some of the menu options for positioning and orientating the current component, like this (the illustration shows the settings which we will be using in the next steps):



39. We will first set up those parts of the form which will remain the same for all components in the current branch.

The top section of the form, **Specifications: Piping**, **Insulation** and **Tracing** (the same as the *Defaults Specifications* form which we used earlier), lets you change the specification for individual components if required. Leave the settings as they are.

The order in which the individual components occur in the branch's members list is very significant, since it determines how implied tubes are routed between them. This order is determined initially by the order in which the components are created. We are going to create the branch members in head-to-tail order; referred to as pipe routing in **Forwards mode**. It is sometimes necessary to work in Backwards mode (i.e. in tail-to-head order), as we will see later, but this needs more care if you are to avoid mistakes. Always work in Forwards mode (click the **Forwards** button) where possible.

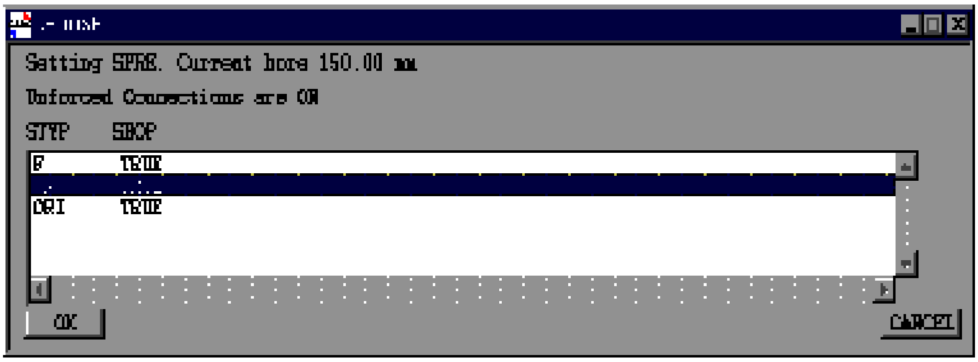
Set the **Default** button **Off**. This means that we will fully specify each component as we create it, rather than relying on default selections predefined in the catalogue specifications.

Set the **Auto Conn** button to **On**. This will connect each new component to its predecessor automatically as it is created (assuming that such a connection is valid).

We are now ready to start creating the individual piping components.

40. Select **Gasket** from the list of component types and then click the **Create** button. An appropriate gasket will be selected from the current specification, and will be positioned at, and connected to, the branch head. (You will not see this in the graphical view because the gasket is too thin to have a geometric representation, but you will see it in the *Members List*.)

Now select **Flange** and click **Create** again. Because the A3B specification includes more than one type of flange, you will see a *Choose* form showing the choices, like this:

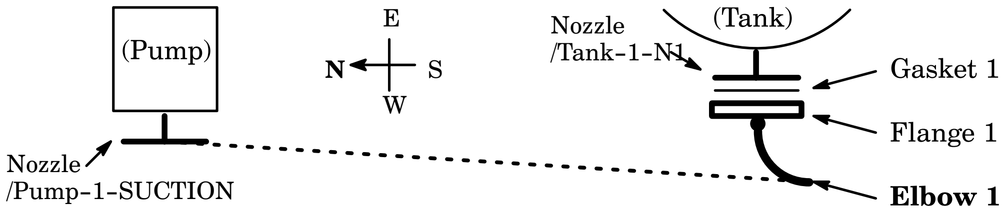


(The default information given on the *Choose* form is rather terse. To see more detail, **Cancel** the *Choose* form, select **Settings>Choose Options** and, on the *Choose Options* form, change the **Selection Criteria** option button from **Basic** to **All**. Then click the **Create** button on the *Piping Components* form again to redisplay the *Choose* form with the extended data, which now includes component descriptions.)

The available types are **F** (plain slip-on flange), **WN** (weld-neck flange) and **ORI** (orifice flange). Select **WN** and then click **OK** to complete the creation process.

The new flange (**Flange 1** in the schematic diagram) will appear in the graphical view as well as in the *Members List*.

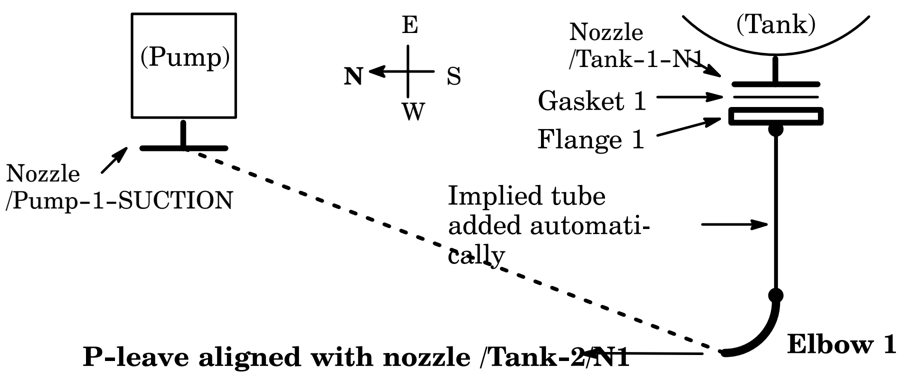
41. The next item we want to create is an **Elbow**, so select this from the list and click the **Create** button. From those listed on the *Choose* form, select type **E**. When the elbow has been created, the graphical view will show it positioned like this:



While the auto-connect function positions and orientates the elbow so that its p-arrive points towards the preceding flange, the application has no way of knowing which way the p-leave of the elbow is to be directed, so it assumes the default direction as set in the catalogue. To specify the required orientation, either select the 'Orientate' option **Direct N** or select the 'Rotate' option **Rotate 180** (think why these have the same effect).

NOTE: Even if the option you want to use is already displayed, for example **Direct N**, you must select it again to carry out the operation.

We also want to position the elbow at a specified distance from Flange 1. To demonstrate a new feature, we will line it up with the lower nozzle on /Tank-2. To achieve this, select the 'Position' option **Thro' ID Cursor**, meaning that the current component is to be aligned with an existing item which you will identify by picking it with the cursor in the graphical view. When prompted, pick /Tank-2/N1. The elbow will be repositioned thus:

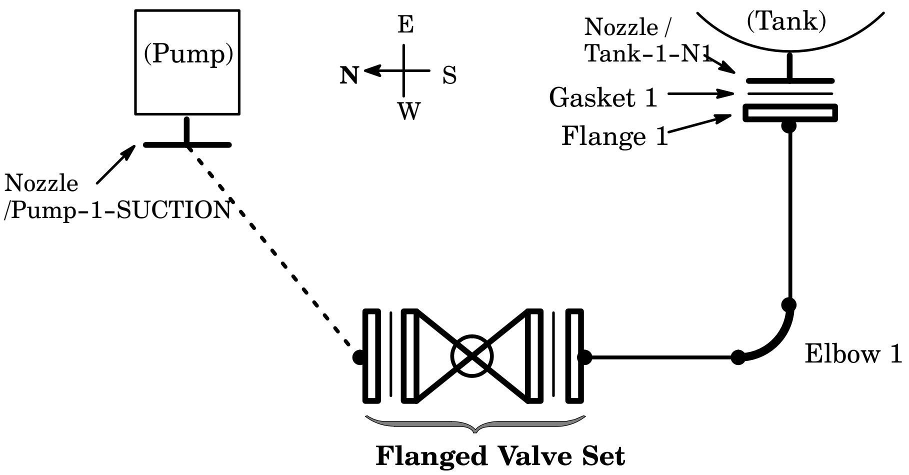


(We will look in more detail at the ways of positioning and orientating items in some later parts of the exercise.)

42. To save time, a number of common configurations of piping components have been predefined so that they can be created in a single step. One such configuration (or **Assembly**) consists of a flanged valve, together with the pipe flanges and gaskets needed to connect it. We will use such an assembly to add **Flange 2**, **Gasket 2**, **Valve 1**, **Gasket 3** and **Flange 3**.

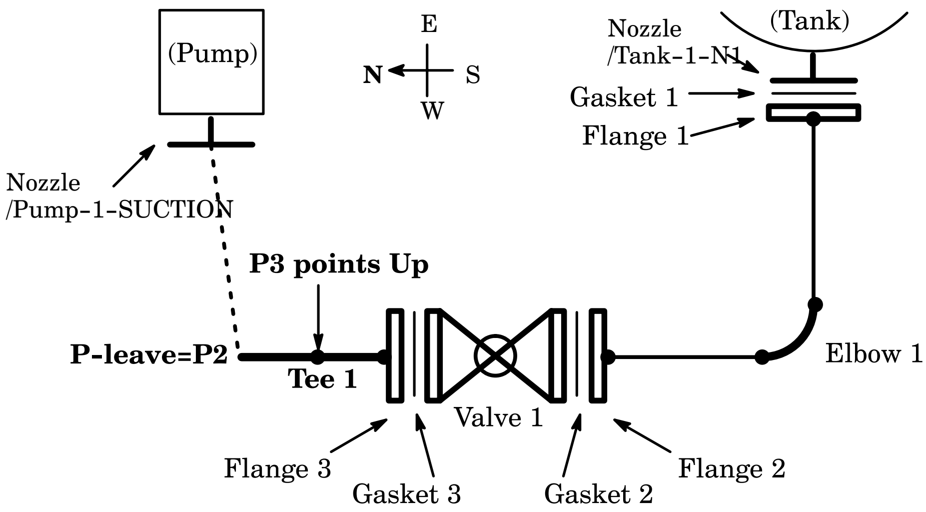
On the *Piping Components* form, select **Assemblies**. When you click **Create** you will see a *Standard Assemblies* form listing the available configurations: select **Flanged Valve Set a Distance** (which means that we will specify the position of the valve set as a distance from the preceding elbow). Enter a **Distance** of **1600**. To orientate the valve's handwheel to point upwards, set **Valve H/W Dir** to **U**. When you **Apply** the *Standard Assemblies* form settings, you will be presented with three *Choose* forms in succession: the first lets you specify the valve type (select **GATE**); the second and third let you specify the inlet and outlet flange types (select **WN** in both cases).

The piping network should now look like this:

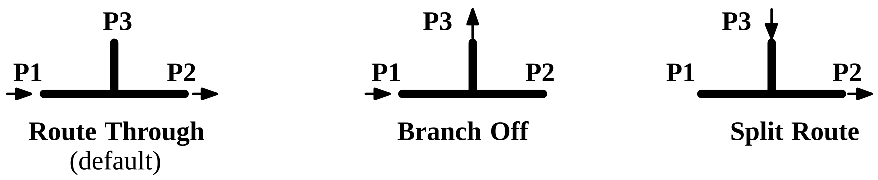


43. Now create a **Tee**. The resulting *Choose* form shows the tees listed by PBOR3 (the bore of their side–arm, as identified by P3). Note that this list includes one special item shown as having PBOR3 set to **1.00**: this represents an **equal tee**, where the bore of the P2 and P3 arms is set automatically to match that of the P1 arm (shown at the top of the form as 150 in our case). Select this as the required type.

When created, the tee is positioned and orientated as follows:



We want the tee outlet (p–leave) to be P3 rather than P2. To change this, with the tee as the current element, select **Modify>Component>Route** from the main menu bar. You will see a *Modify Route* form giving the following options:



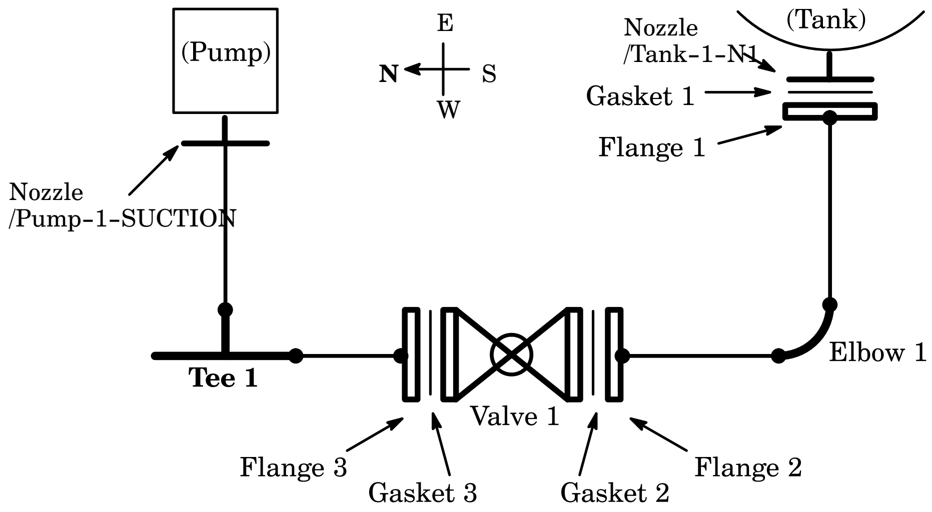
Select **Branch Off** and notice how the branch route leaving the tee moves from P2 to P3 when you apply the change.

Orientate the tee, using either the 'Orientate' or 'Rotate' option on the *Piping Components* form, so that its P3 direction is East.

To align the tee with the pump nozzle, you can use the 'Position' options in several ways. Use any one of the following (but read them all so that you understand the principles):

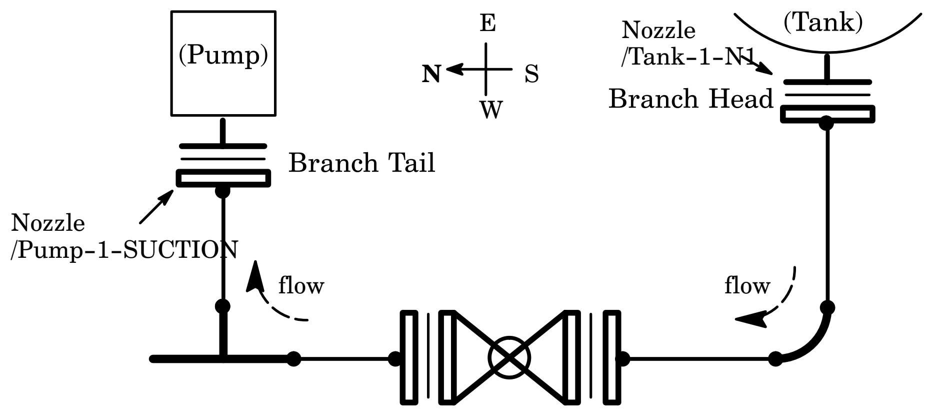
- Select **Thro' Tail** or **Thro' Next** (these are the same, since the tail is effectively the next item in the branch list).
- Select **Thro' ID Cursor** and, when prompted, pick the nozzle in the graphical view.
- Select **Thro' Point** and, when prompted, pick the p–point at the centre of the nozzle flange.

The resulting pipework layout should now look like this:



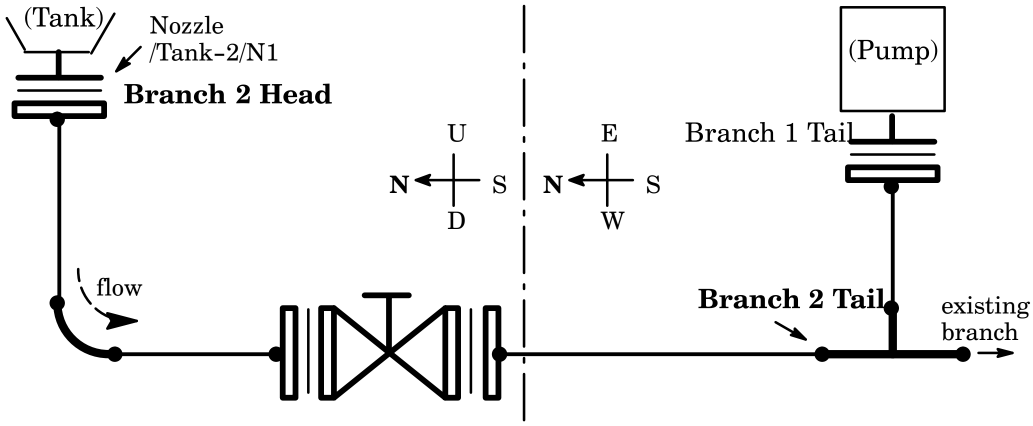
(Note that a length of implied tube is now shown between the tee outlet and the branch tail, even though the final components have not yet been inserted. This confirms that the alignment and bore sizes of the tee outlet and branch tail are compatible.)

44. Complete the branch by adding a weld-neck flange and gasket, connected to the branch tail, by selecting **Flange Gasket to Tail** from the **Assemblies** options. The result should be:



6.6 Creating a Second Pipework Sequence

To allow you to practice and reinforce the techniques learned in creating the preceding pipework sequence, we will now create a similar branch, also part of /Pipe–1, which runs from the nozzle /Tank–2/N1 to the open connection on the tee of our existing branch, thus:



NOTE: The broken line marks a change of view direction: components to the left are shown looking **East** (i.e. they lie in a vertical plane through the tank nozzle); components to the right are shown looking **Down** (i.e. they lie in the same horizontal plane as our existing Branch 1).

Exercise continues:

45. Navigate to /Pipe–1 and create a second branch **/Pipe–1/B2**. Connect its **Head** to **Nozzle** /Tank–2/N1 and connect its **Tail** to the **Tee**. (Notice how the branch route goes automatically to the free connection on the tee; you do not have to pick any particular point on the tee when you connect the tail.)

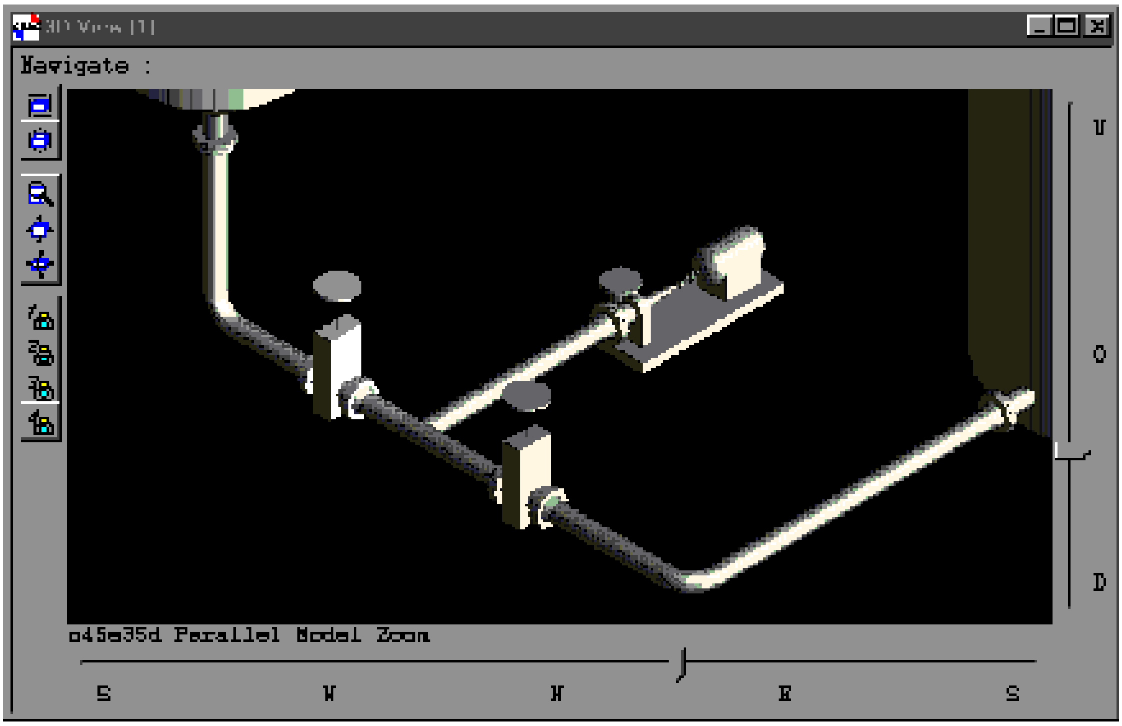
46. Create a **gasket** and **flange** connected to the branch head: select **Gasket Flange to Head** on the *Standard Assemblies* form; choose flange type **WN** on the *Choose* form.

47. Create an **elbow**: select type **E** on the *Choose* form. Orientate and position the elbow so that its leave connection is aligned with the branch tail (for example, **Rotate 180** and **Thro Tail**).

(Implied tube should now be shown between the elbow and the tee, confirming that the alignment and connecting bore sizes are correct.)

48. Create the **valve** and its associated **flanges** and **gaskets** as an assembly: select **Flanged Valve Set a Distance** on the *Standard Assemblies* form, with the **Distance** set to **1200** and the **Valve H/W Dir** set to **U**; choose valve type **GATE** and flange type **WN** on the *Choose* forms.

Zoom in on the pipework; it should now look like this:



This completes the introduction to the basic pipe routing operations. In the following parts of the exercise we will look at some ways of checking the design model and outputting some design data derived from the database settings.

7 Checking and Outputting Design Data

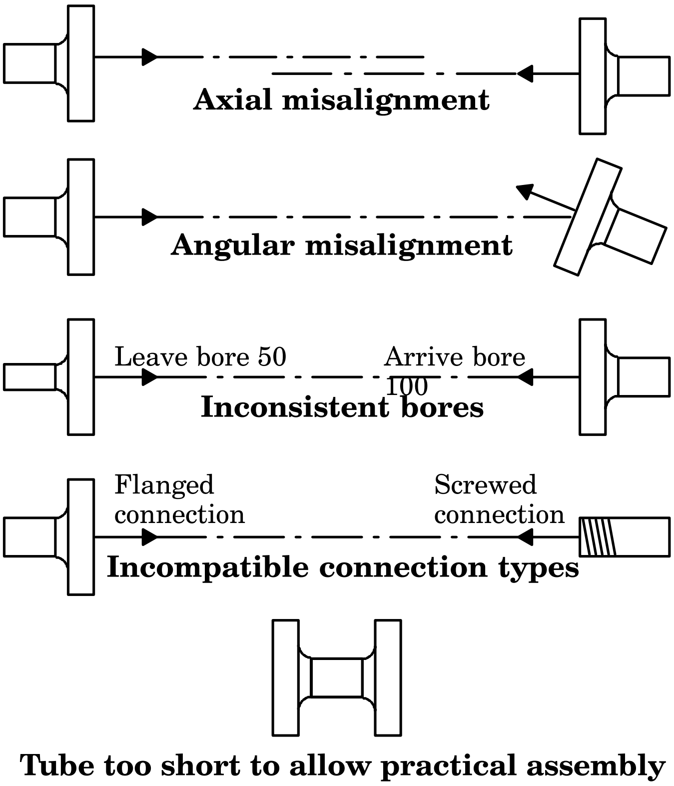
To ensure maximum design integrity, the pipework application lets you check the data in several ways so that any potential mistakes are drawn to your attention. In this chapter we will look at the methods of checking for errors and inconsistencies in the pipework layout, and for clashes (spatial interferences) between design elements.

We will then look at two ways of outputting design data derived from the piping model: the generation of a tabulated report showing the material required to build the design; and the creation of an isometric plot showing the pipe layout and associated manufacturing data.

NOTE: The facilities which we will be using here are available from *all* design applications, so you can readily check and output data from any combination of design disciplines (in our case both Equipment and Pipework design.)

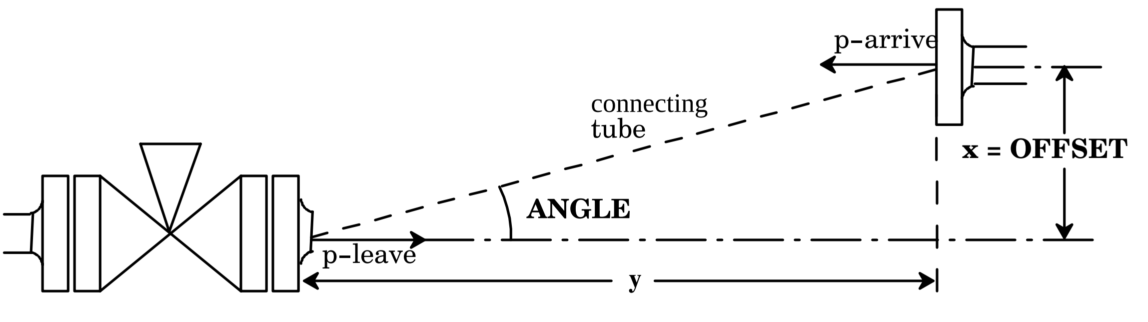
7.1 Checking for Design Data Inconsistencies

The data consistency checking utility reports the following types of occurrence (and other similar errors) in the design:



Design Tolerances

The misalignment between adjacent components may be measured using any of three parameters: the **offset** distance between their p–arrive and p–leave axes; the displacement **angle** between their p–arrive and p–leave axes; or the **ratio** of the offset to the projected distance between the arrive and leave p–points (equivalent to the tangent of the angle parameter).



You can specify maximum permissible values for any of these parameters, as well as minimum acceptable lengths of tube between components (you can specify different minimum lengths for different bores if you wish). If any part of the design falls outside the current limits, an error message will warn you.

Exercise continues:

49. To check your design for data consistency errors, select **Utilities>Data Consistency**. You will see a *Data Consistency Check* form. We will use the default values for all piping design tolerance settings: to see what these are, click the **Parameters: Piping** button to display the *Piping Consistency Check Options* form. Think about the meaning of each setting shown (refer to the preceding introduction); then Cancel the form.

50. You can send the error report either to your screen or to a file. We will view it on screen, so select the **Output: Terminal** button.

51. The **Check:** list lets you specify how much of the design model you want to check in a single operation. We will check each branch separately, so select **Branch** from the list.

Navigate to the branch **/Pipe-1/B1** and click **Apply** to initiate the data checking process. The resulting diagnoses will be shown in the scrollable text area at the bottom of the form. Hopefully the message you see will say 'NO DATA INCONSISTENCIES'. (Do not worry about any messages about SKEYs which you might see.)

Repeat the check for branch **/Pipe-1/B2** and note how the result (hopefully the same message) is appended to the preceding report.

It is good practice to run a data consistency check whenever you have created or modified any significant amount of the design, typically before you do a Savework operation.

It is particularly important that the design should be free from data consistency errors before you generate isometric plots for fabrication and/or erection purposes, otherwise you could get some very confusing results.

7.2 Checking for Clashes

The types of clash identified depend on two factors:

- The **obstruction levels** of the clashing elements
- The current **touch** and **clearance** tolerances

Obstruction Levels

All design primitives and all catalogue primitives have an obstruction attribute (OBST) which defines the physical type of obstruction which the primitive represents:

- A **hard obstruction** (OBST=2) represents a rigid and impenetrable object, such as a steel beam or a plant vessel.
- A **soft obstruction** (OBST=1) represents a volume which is not solid but which needs to be kept clear for access.
- Any primitive with OBST=0 represents a freely accessible volume and is ignored for clash checking purposes.

Extent Of Clashing

As well as distinguishing between hard and soft clashing items, the checking utility recognises three categories of clash between them, depending on how far the two primitives intrude on each other's allocated space. These categories are:

- A **physical clash**: the primitive volumes overlap by more than a specified amount. This usually means that a definite interference exists.
- A **touch**: the primitives *either* overlap by less than the amount needed to cause a clash *or* are separated at their closest point by less than a specified distance. This may simply mean that one item is resting upon another as intended, or it may indicate a problem.
- A **clearance**: the primitives are separated at their closest point by more than the amount necessary to constitute a touch but less than a specified clearance distance. This represents a 'near miss', which you may want to investigate.

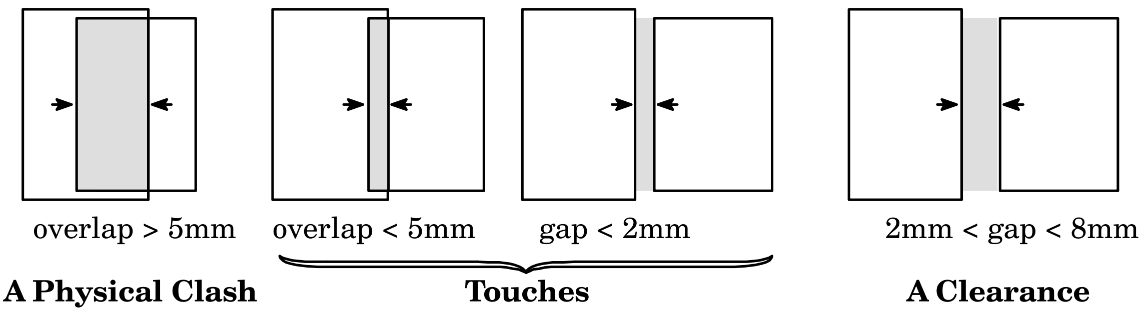
These three classes are illustrated below for the clash specifications:

Touch limits: 5mm overlap to 2mm gap

Clearance limit: 8mm

so that the following criteria apply:

- If the items overlap by more than 5mm, a clash is reported
- If the items overlap by less than 5mm, a touch is reported
- If the items do not overlap but are separated by less than 2mm, a touch is reported
- If the items are separated by more than 2mm but less than 8mm, a clearance is reported
- If the items are separated by more than 8mm, no interference is found



The Clash Detection Process

Each element which is to be checked for clashes has its own geometry checked against that of all other elements which are specified by a current **obstruction list**. Items which are not in the obstruction list are ignored during the clash checking operations. By default, the obstruction list includes all elements in the database, so that each element to be clash checked is tested against every other element. To control the amount of checking carried out in a large database, you can restrict the obstruction list to a few specific elements and/or you can specify a 3D volume (the **clash limits**) within which the clash checking is to be confined.

To highlight the locations where clashes are found, the clashing and obstruction items are shown in contrasting colours in the graphical view (two shades of red, by default).

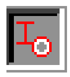
Exercise continues:

52. We will use the default values for all clash checking settings. To see what these are, select **Settings>Clasher>Defaults** to display the *Clash Defaults* form. Think about the meaning of each setting shown (refer to the preceding introduction); then Cancel the form.

53. We will check all of our piping components (that is, the whole of /PIPEZONE) for clashes against the three equipment items (in /EQUIZONE). The default obstruction list (*all* elements in the current design database) will include both piping and equipment items (/PIPESITE). To edit this, select **Settings>Clasher> Obstruction>List**. You will see an *Add/Remove Obstruction Items* form which is used in a similar way to the *Members+Draw* form (as introduced in Step 12). **Remove** all current entries and then **Add** the equipment zone.

54. Navigate to the piping zone which you want to check and select **Utilities>Clashes**. You will see a *Clash Display* form. The left-hand side of this form controls the clash checking process; the right-hand side consists of a 3D view in which you can look in detail at any clashes diagnosed. Select **Control>Check CE** from the form's menu bar to run the clash checking process and, when completed, study the **Clash List** which shows any clashes found.

In our case this should simply say 'None'.

NOTE: If the **Auto Clash** button is set to On, thus: , each new element that you create is checked immediately for clashes as the design is built up. This can slow down progress when you are adding many new elements, but is very useful when you want to add a few new items to an existing design which has already been checked for clashes.

7.3 Generating a Data Output Report

The reporting utility lets you read selected information from the database and present the output in a tabulated format. Each report can be customised by specifying some or all of the following:

- Where the output is to appear (on the screen or in a file ready for printing).
- Any introductory header which is to appear at the beginning of the report.
- The page length (if the report is to be paginated).
- The page layout, including number and positions of columns, column headings, etc.
- Any headers and footers which are to appear at the top and bottom of each page.
- The selection criteria which define which data settings are to be included in the report.

Once such a report has been designed, its specification can be saved for future use in the form of a **report template** file. The ways in which you define how a given report is to be generated and presented are beyond the scope of this exercise, but we will look at the results of the process by using a pre-prepared template which outputs a material take-off list showing the length of tube needed to build our design. (You will probably use your company's standard templates for most reports anyway, in which case this is the method you would normally use in practice.)

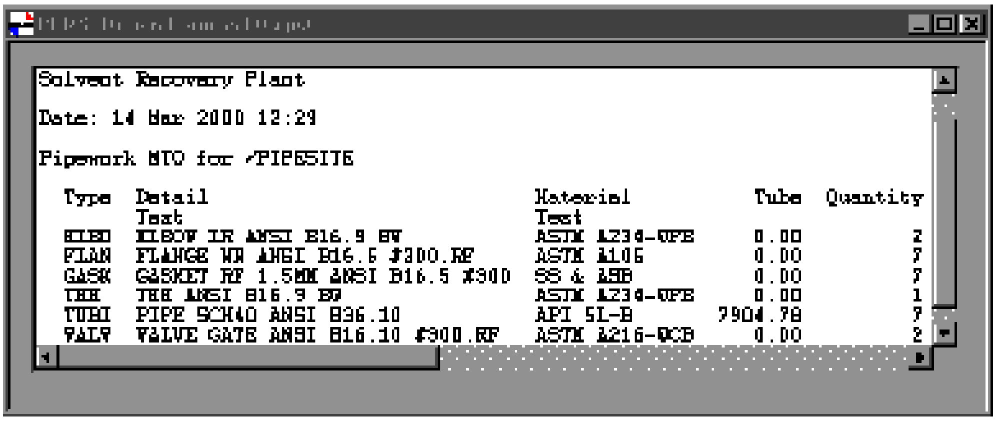
Exercise continues:

55. Select **Utilities>Reports>Run** to initiate the reporting process. You will see a *File Browser* listing all files in the current reporting directory (specified by your System Administrator as part of the project set-up procedure). Check that you are in the ...\REPORTS\TEMPLATES directory. All files with a .tmp suffix are report templates. Select **pipe_mto.tmp**, which has been designed to produce a material take-off report listing all components, including tubing, in the piping design. Click **OK** on the *File Browser*.

56. To run the report defined by the chosen template, you must specify two things (as determined by the rules within the template): where the report is to appear, and what part of the database hierarchy is to be read when extracting the required types of data. When you clicked **OK** on the *File Browser* to specify the template, a *Report Details* form appeared which lets you do this.

Leave the **Filename** text-box empty (which will send the report to the screen automatically). In the **Hierarchy** text-box, enter /**PIPESITE**, since we want to list the tubing requirement for the whole of the piping design model. Click **OK** to run the report.

57. The tabulated report output will be displayed in a *Command Output* window which is opened automatically, like this:



This report shows the number of each type of component used in the design and the total length of tube needed to interconnect them. (Do not worry if part of the heading seems inappropriate for your project; this wording is written into the template simply as an example of the type of heading which you might want to use.)

7.4 Generating Isometric Plots

The isometric plotting module of PDMS provides very powerful facilities for generating any specified isometric view of all or part of the pipework design, with associated parts lists and annotation, with a very high degree of user control over the output format. We will use just a small part of this power to produce a plot of our design using the default settings only.

NOTE: Before you proceed further, you must have carried out the data consistency checks specified in Steps 49 to 51 and achieved an error-free report.

Exercise continues:

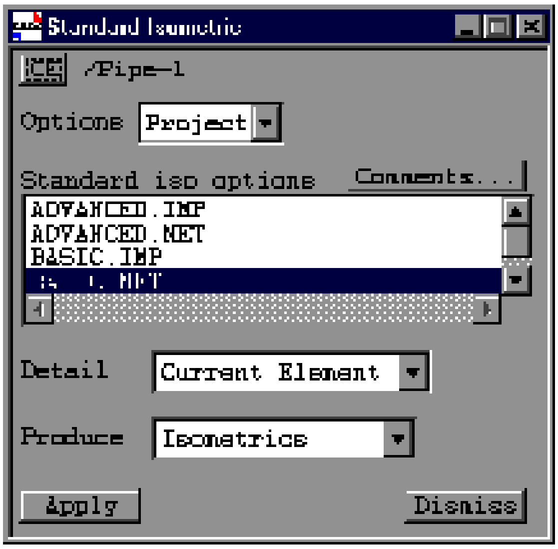
58. To change to the isometric plotting module (called ISODRAFT), select **Design>Modules>Isodraft>Macro Files**.

Confirm that the database is to be updated to save any design changes since your last Savework; ISODRAFT will then be loaded.

When loading is complete, you will see the Isodraft menu bar like this:

This deceptively simple menu gives you access to a wide range of facilities for generating customised isometric plots to suit all likely purposes. For the purposes of this exercise, we will simply generate a standard isometric for the whole pipe (i.e. both branches) using default settings for all options.

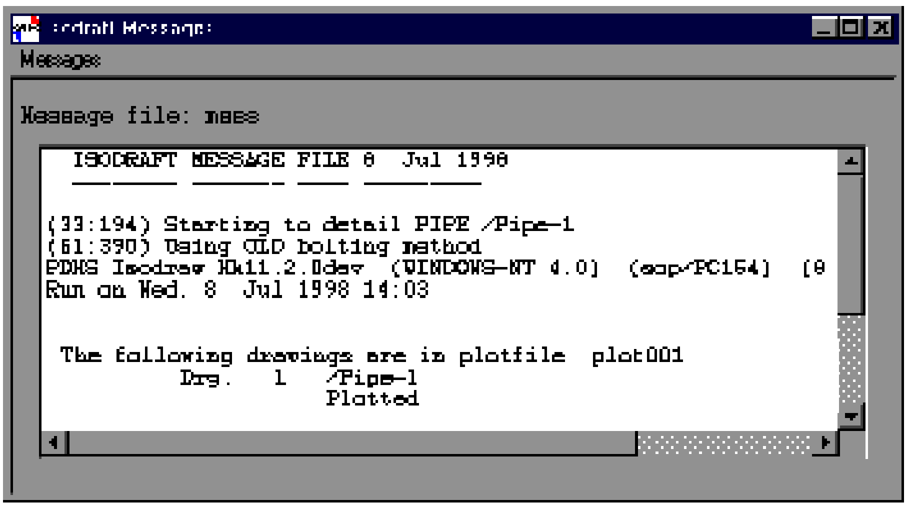
59. Navigate to /**Pipe-1** in the *Isodraft Members List* and then select **Isometrics>Standard**. You will see a *Standard Isometric* form which lets you specify which parts of the piping design are to be detailed in the plot and which of the standard drawing formats is to be used. Select **Standard iso option BASIC.MET**, like this:



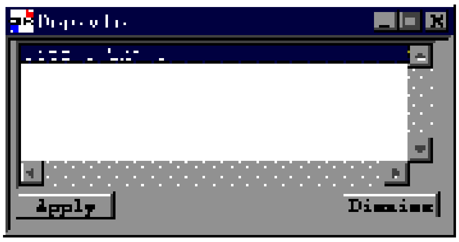
and click **Apply** to initiate the isometric plotting process.

The status bar will display the message 'Please wait, detailing in progress' while the isometric view is composed, the dimensioning annotations are calculated, and the material take-off report is compiled. On a large process plant model this could take many minutes, but with our very simple model it should take only seconds. When processing is complete, the following new windows will be displayed:

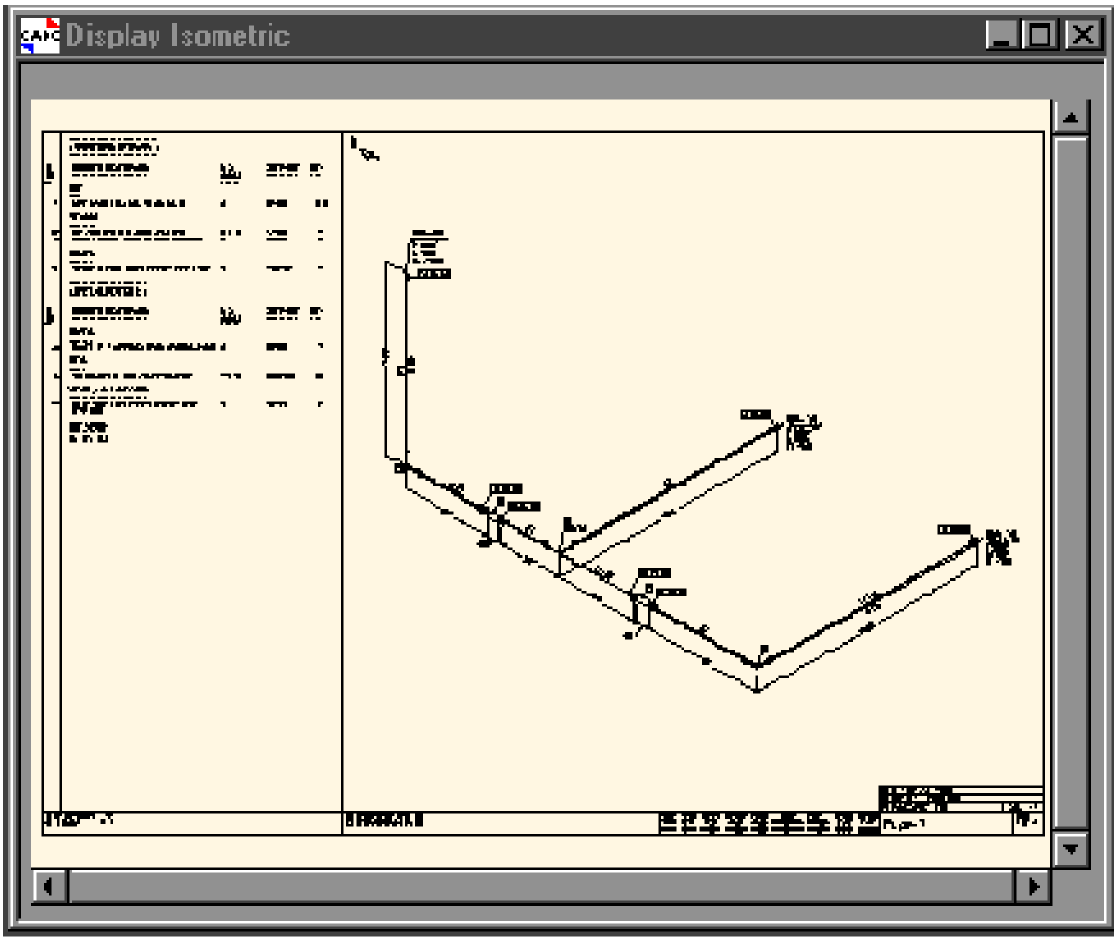
- ***Isodraft Messages*** shows a log of the detailing process, including reports of any potential problems encountered. An error-free message file will contain the following information:



- ***Display List*** shows all isometric plots which have been created so far and which are available for display. In our case there is only one, so it is selected for display automatically, thus:



- ***Display Isometric*** consists of a 2D graphical view showing the plot currently selected in the *Display List*. The current display should look like this:



The same data is also sent automatically to a file in your current operating system directory, ready to be sent to a plotter if a hardcopy version is required. Such files are named by default with a sequential number of the format plot00*x*, where *x* is incremented from 1.

60. Using the same standard layout, generate separate isometric plots for each of the branches /Pipe–1/B1 and /Pipe–1/B2. Compare the information on each of these with the overall plot of /Pipe–1.

(Printed plots of all three isometrics, on a larger scale than the preceding illustration, are in Appendix D.)

7.5 Conclusion

That concludes both the tutorial exercise and this introduction to some of the ways in which PDMS and the CADCENTRE applications can help you in your piping design work. We hope that working through this book has given you an insight into the potential power of PDMS and that you will have gained sufficient confidence to explore some of the more advanced options on your own.

For further technical details, refer to the sources of information listed in Appendix C.

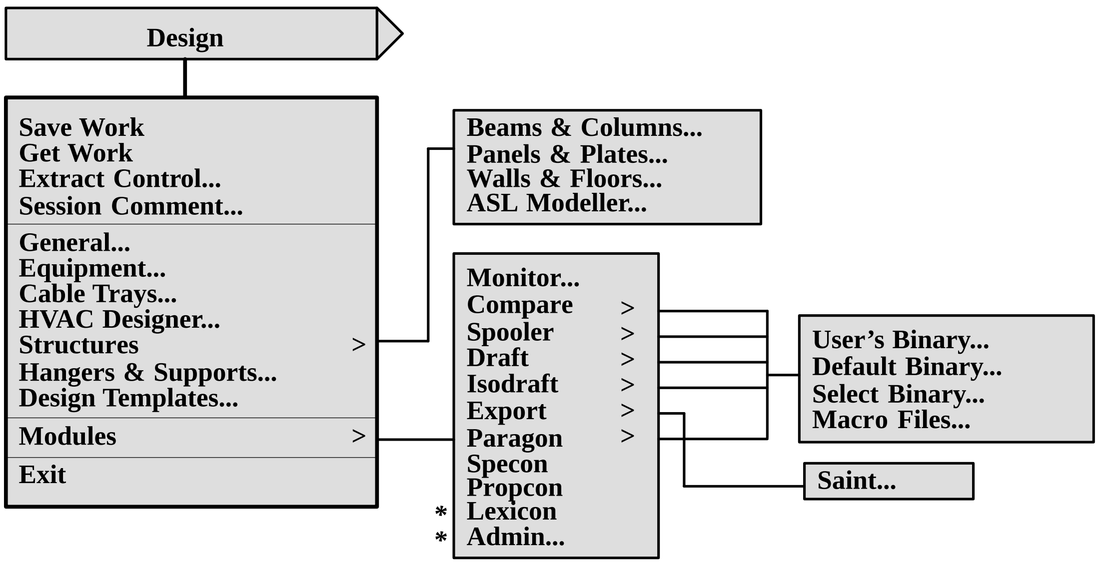
If you have not already done so, you are strongly advised to attend one or more of the specialised PDMS training courses, which will show you how to get the maximum benefits from the product in your own working environment (see Section 1.3).

Part III
Reference Appendices

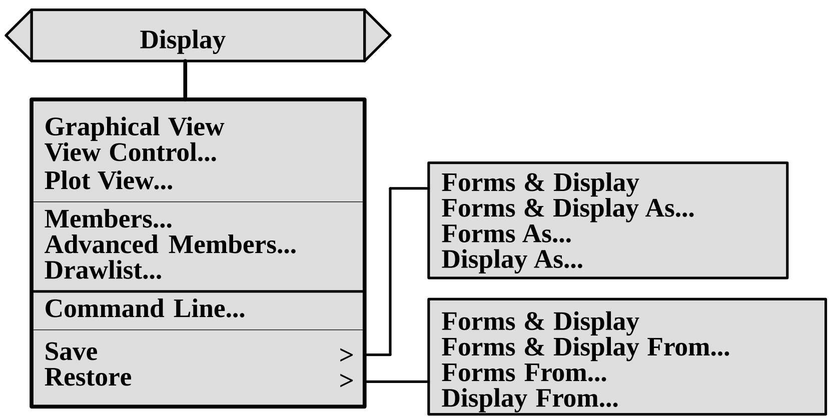
A The Menu Hierarchies

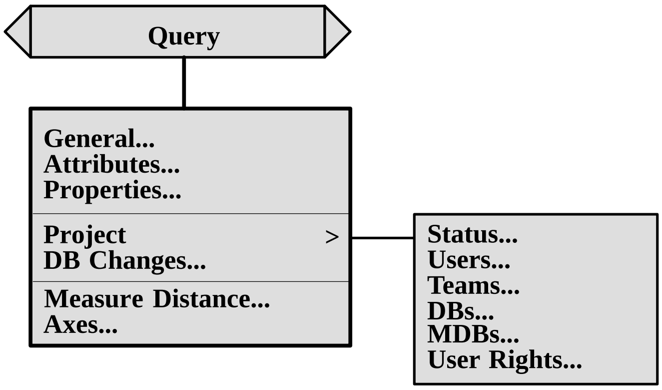
This appendix shows the principal menu hierarchies in a quick-reference format, to allow you to find the option you want rapidly.

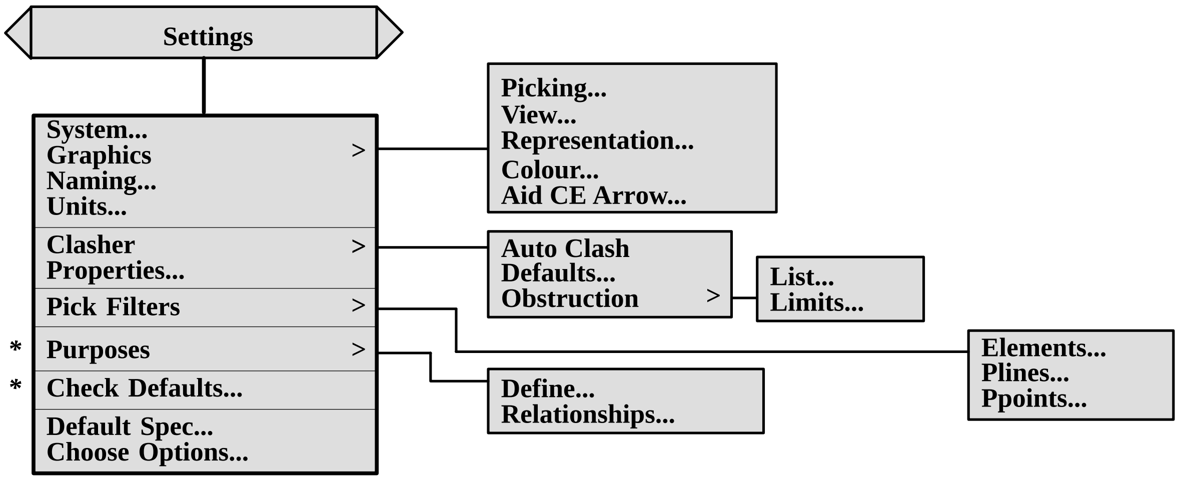
A.1 The *Pipework Application* Menus



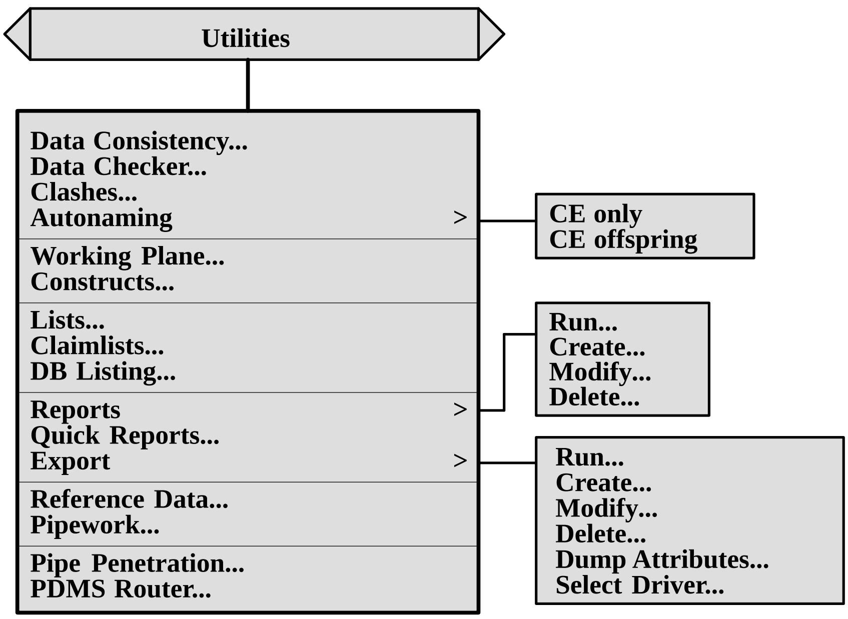
* *Note: These modules are available only if you are logged in as a Free user (e.g. System)*

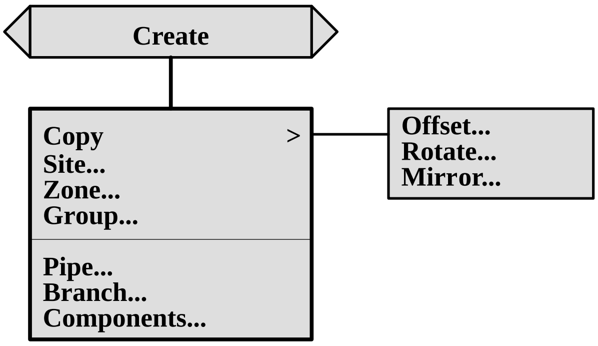


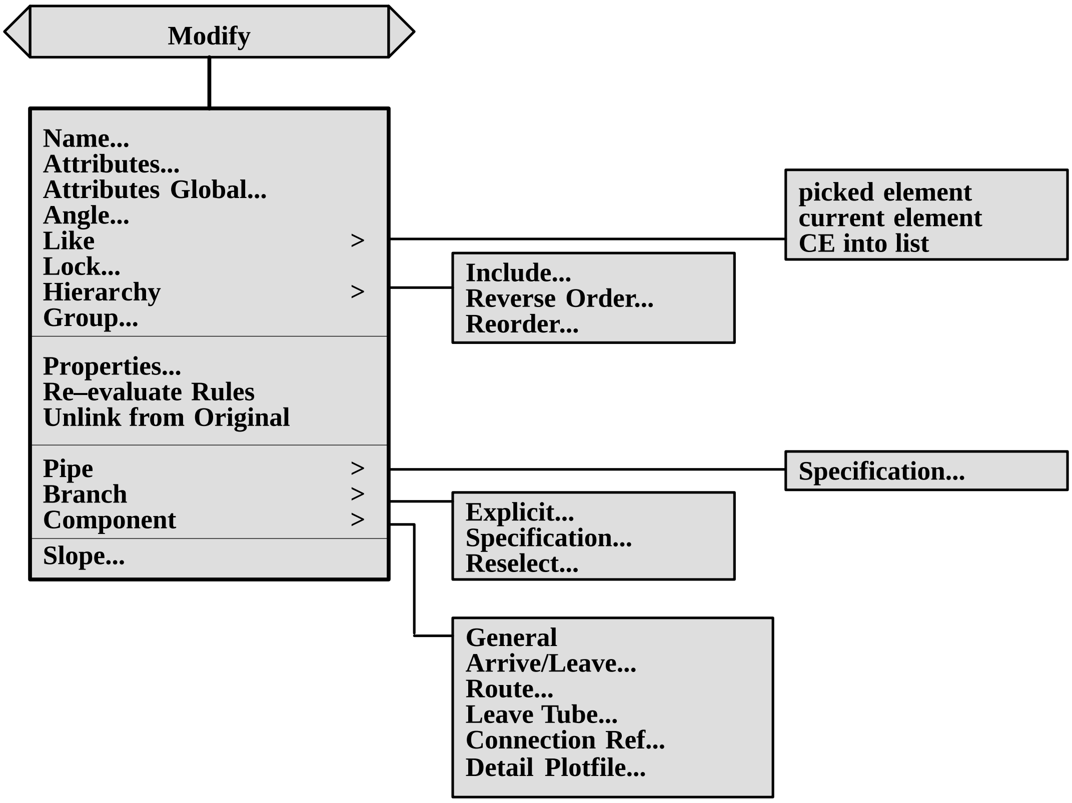


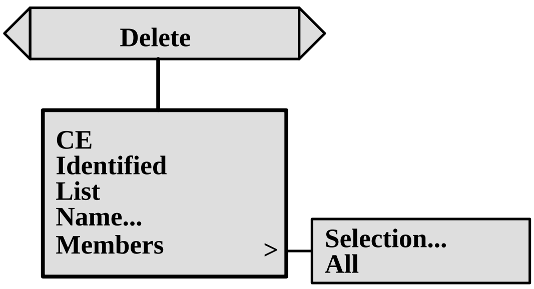


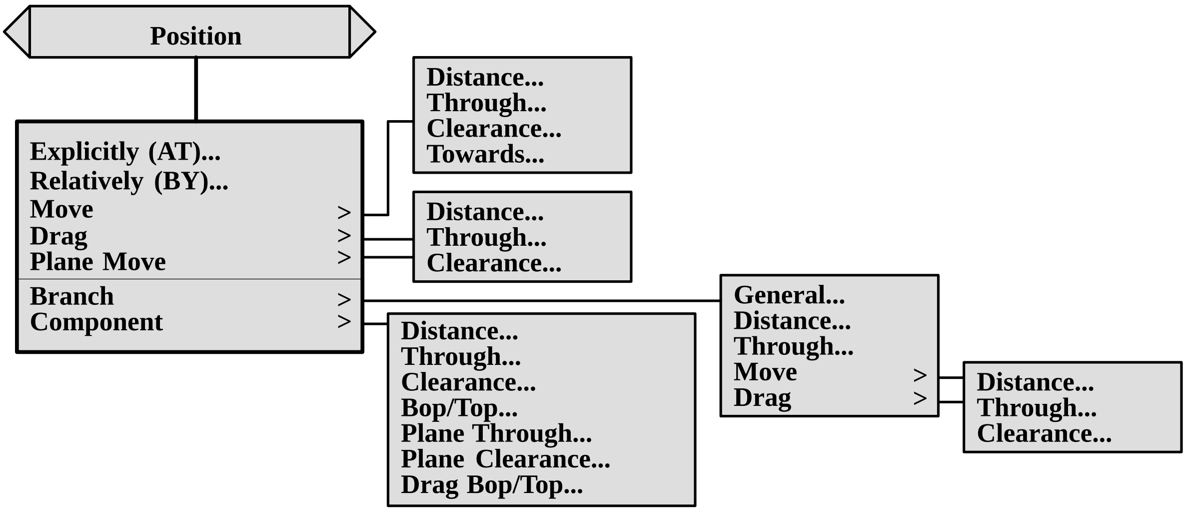
* *Note: These options are available only if you are logged in as a Design administrator.*

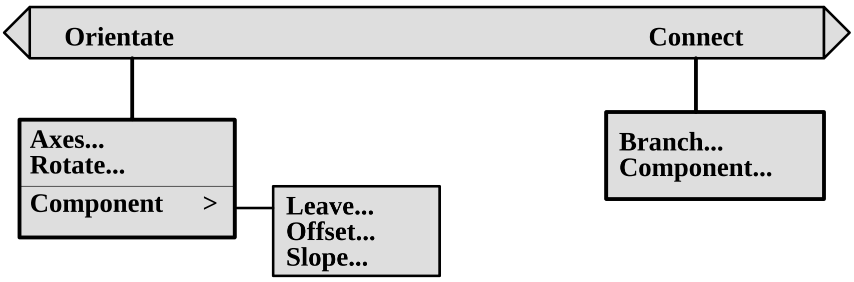


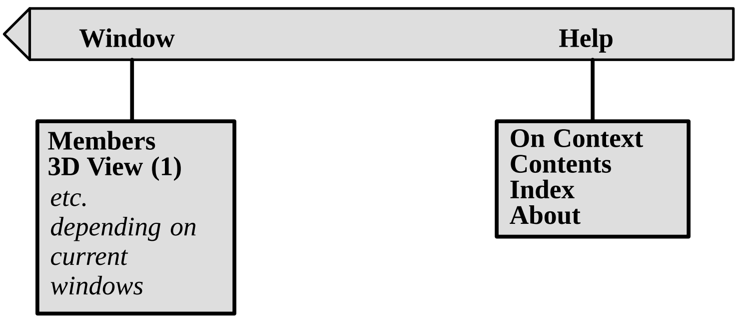

Create
Copy >
Site...
Zone...
Group...
Pipe...
Branch...
Components...
Offset...
Rotate...
Mirror...


Modify
Name...
Attributes...
Attributes Global...
Angle...
Like >
Lock...
Hierarchy >
Group...
Properties...
Re–evaluate Rules
Unlink from Original
Pipe >
Branch >
Component >
Slope...
picked element
current element
CE into list
Include...
Reverse Order...
Reorder...
Specification...
Explicit...
Specification...
Reselect...
General
Arrive/Leave...
Route...
Leave Tube...
Connection Ref...
Detail Plotfile...

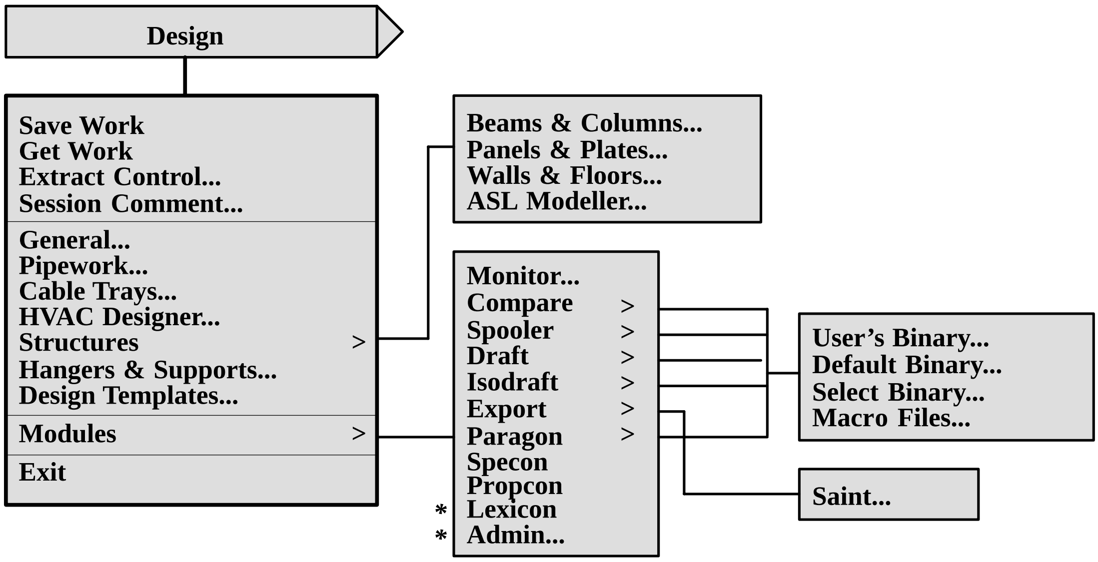

Delete
CE
Identified
List
Name...
Members >
Selection...
All


Position
Explicitly (AT)...
Relatively (BY)...
Move >
Drag >
Plane Move >
Branch >
Component >
Distance...
Through...
Clearance...
Towards...
Distance...
Through...
Clearance...
General...
Distance...
Through...
Move >
Drag >
Distance...
Through...
Clearance...
Distance...
Through...
Clearance...
Bop/Top...
Plane Through...
Plane Clearance...
Drag Bop/Top...

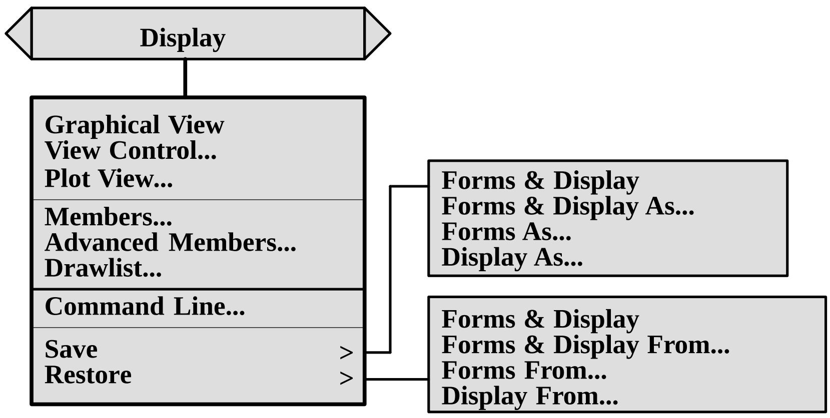

Orientate
Connect
Axes...
Rotate...
Component >
Leave...
Offset...
Slope...
Branch...
Component...

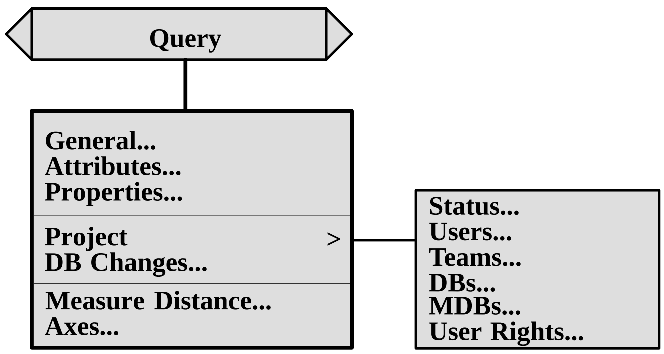

Window
Help
Members
3D View (1)
etc.
depending on
current
windows
On Context
Contents
Index
About

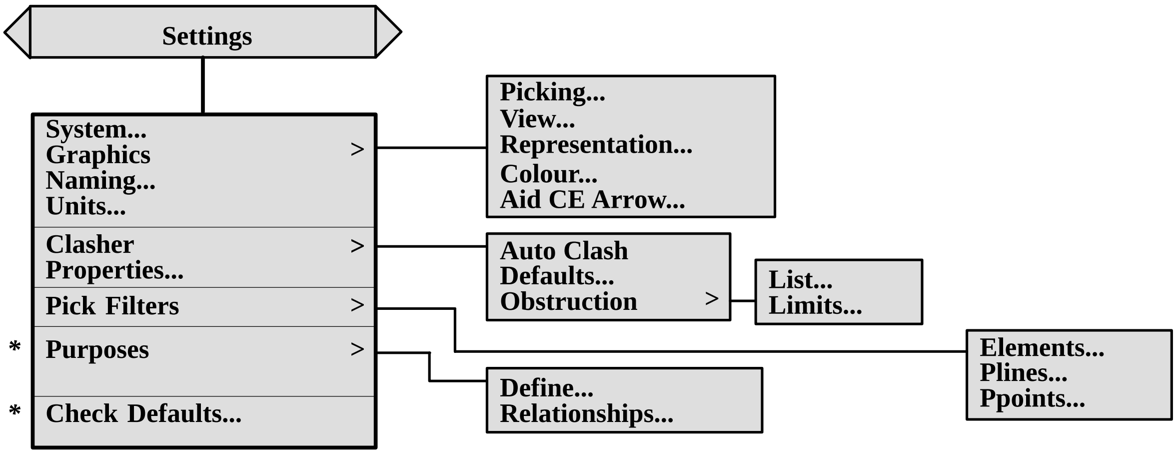
A.2 The *Equipment Application* Menus



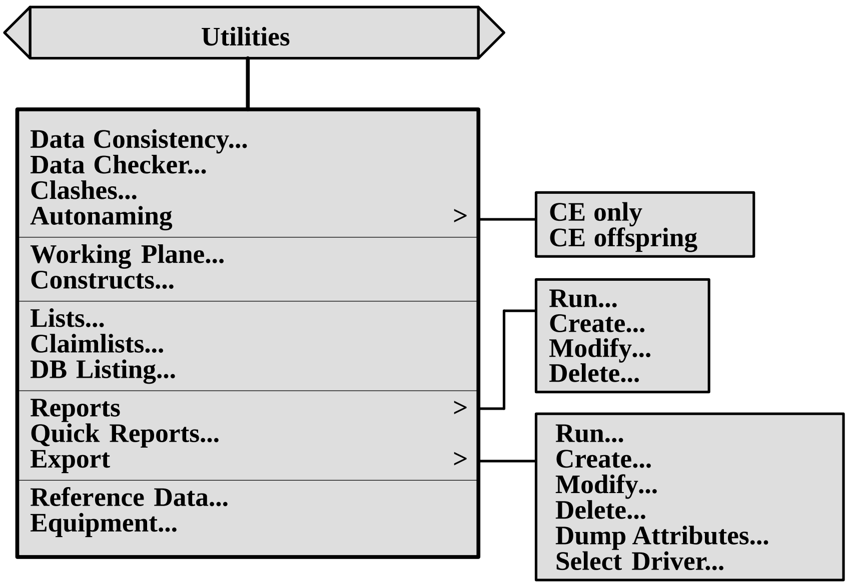
* *Note: These modules are available only if you are logged in as a Free user (e.g. System)*

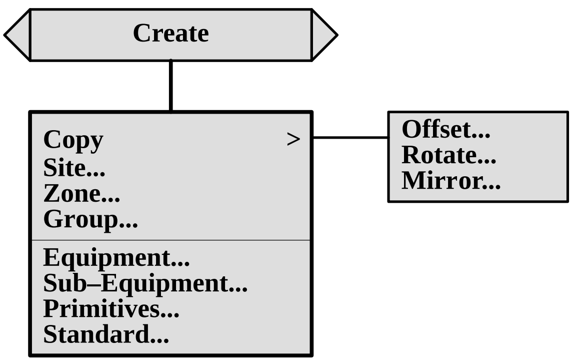


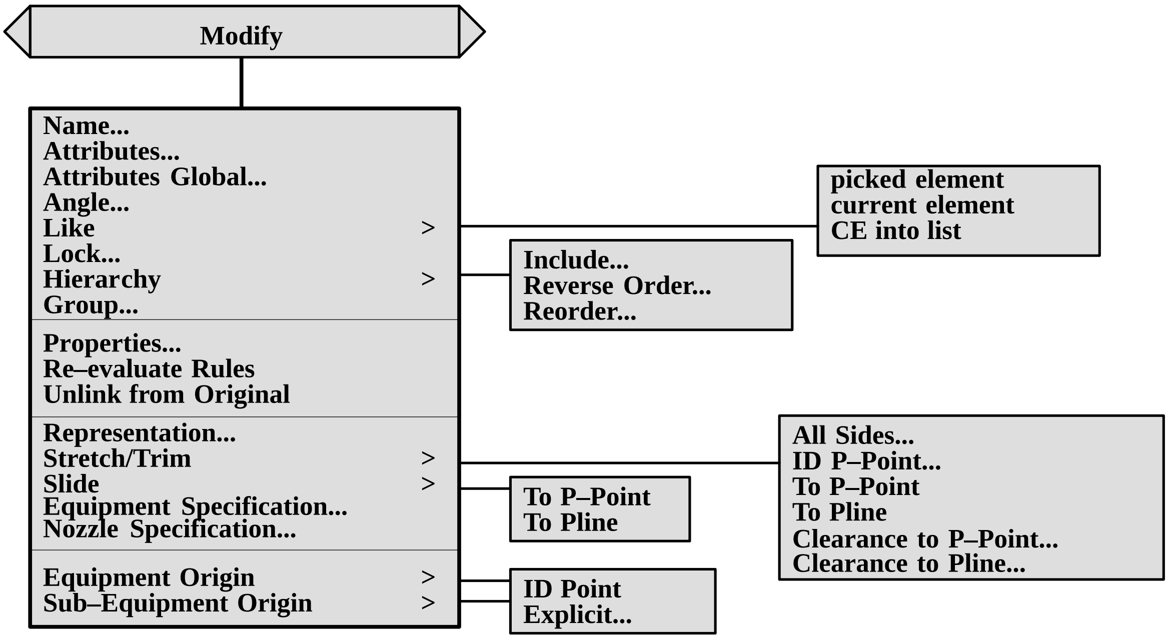


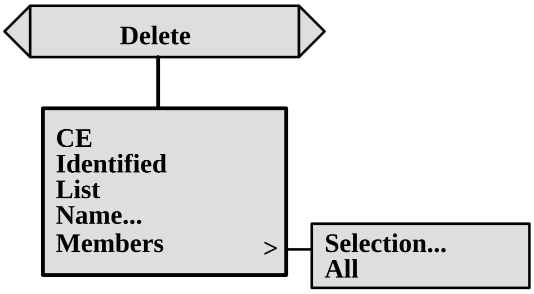


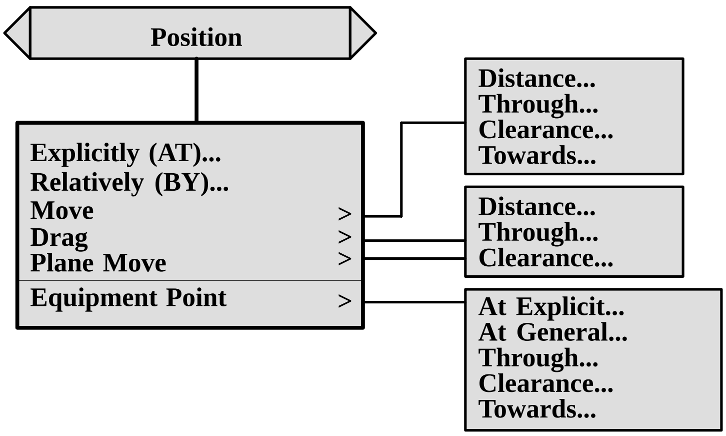
Note: These options are available only if you are logged in as a Design administrator.

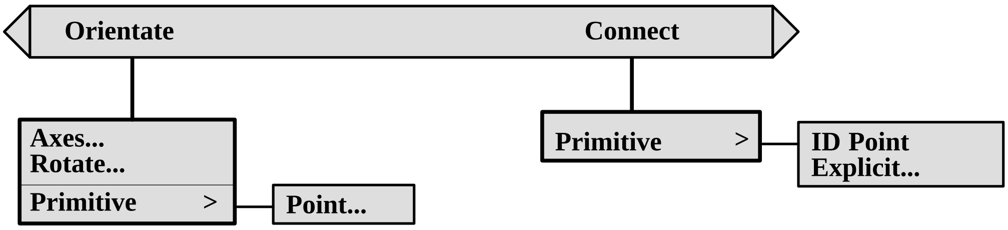


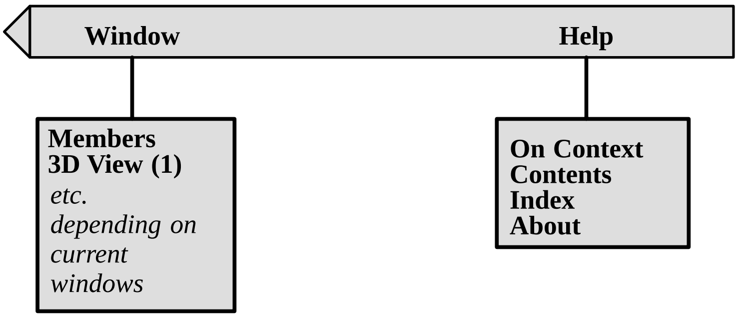



Modify
Name...
Attributes...
Attributes Global...
Angle...
Like >
Lock...
Hierarchy >
Group...
Properties...
Re–evaluate Rules
Unlink from Original
Representation...
Stretch/Trim >
Slide >
Equipment Specification...
Nozzle Specification...
Equipment Origin >
Sub–Equipment Origin >
picked element
current element
CE into list
Include...
Reverse Order...
Reorder...
All Sides...
ID P–Point...
To P–Point
To Pline
Clearance to P–Point...
Clearance to Pline...
To P–Point
To Pline
ID Point
Explicit...

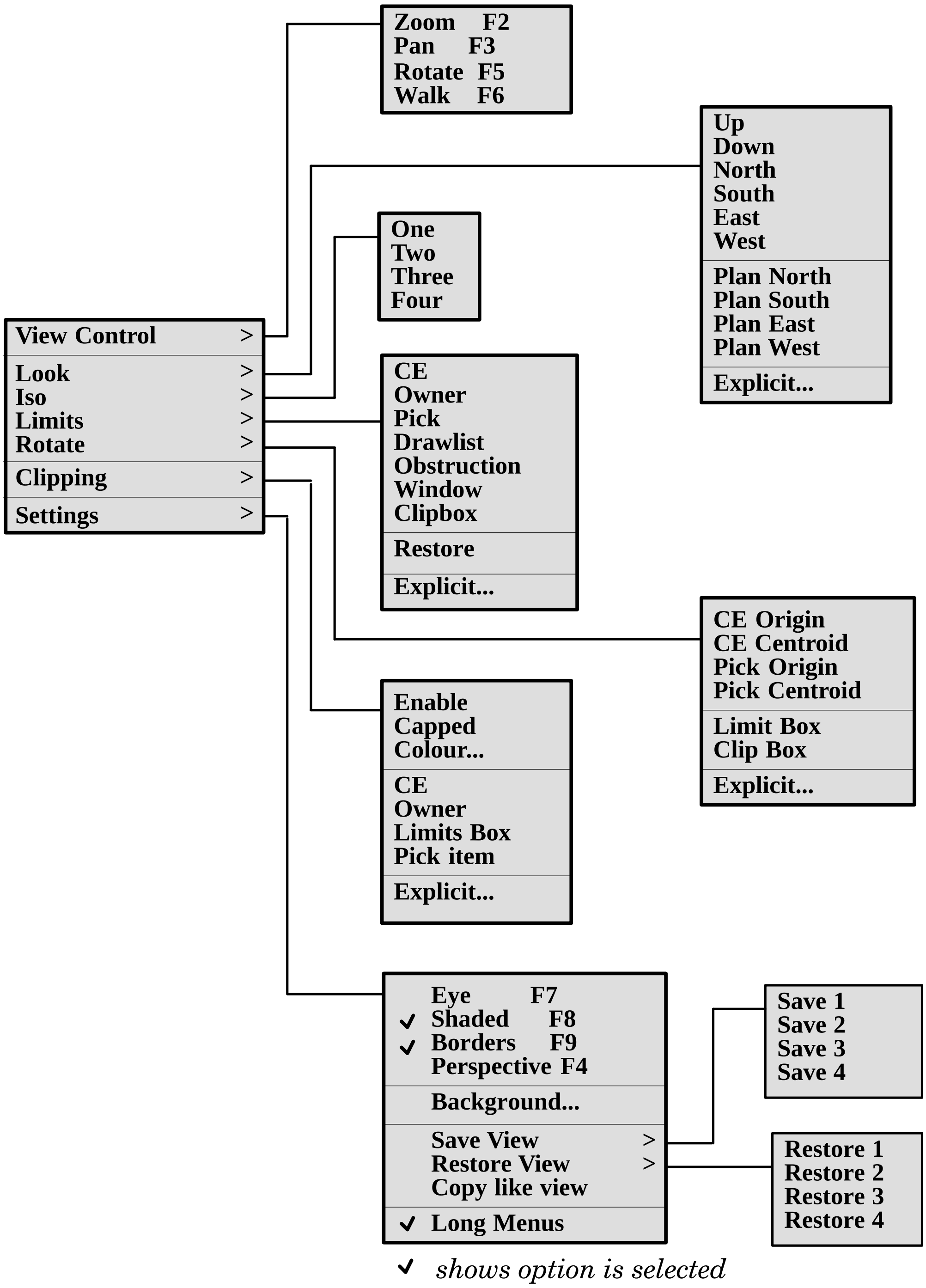

Delete
CE
Identified
List
Name...
Members >
Selection...
All


Position
Explicitly (AT)...
Relatively (BY)...
Move >
Drag >
Plane Move >
Equipment Point >
Distance...
Through...
Clearance...
Towards...
Distance...
Through...
Clearance...
At Explicit...
At General...
Through...
Clearance...
Towards...


Orientate
Connect
Axes...
Rotate...
Primitive >
Point...
Primitive >
ID Point
Explicit...

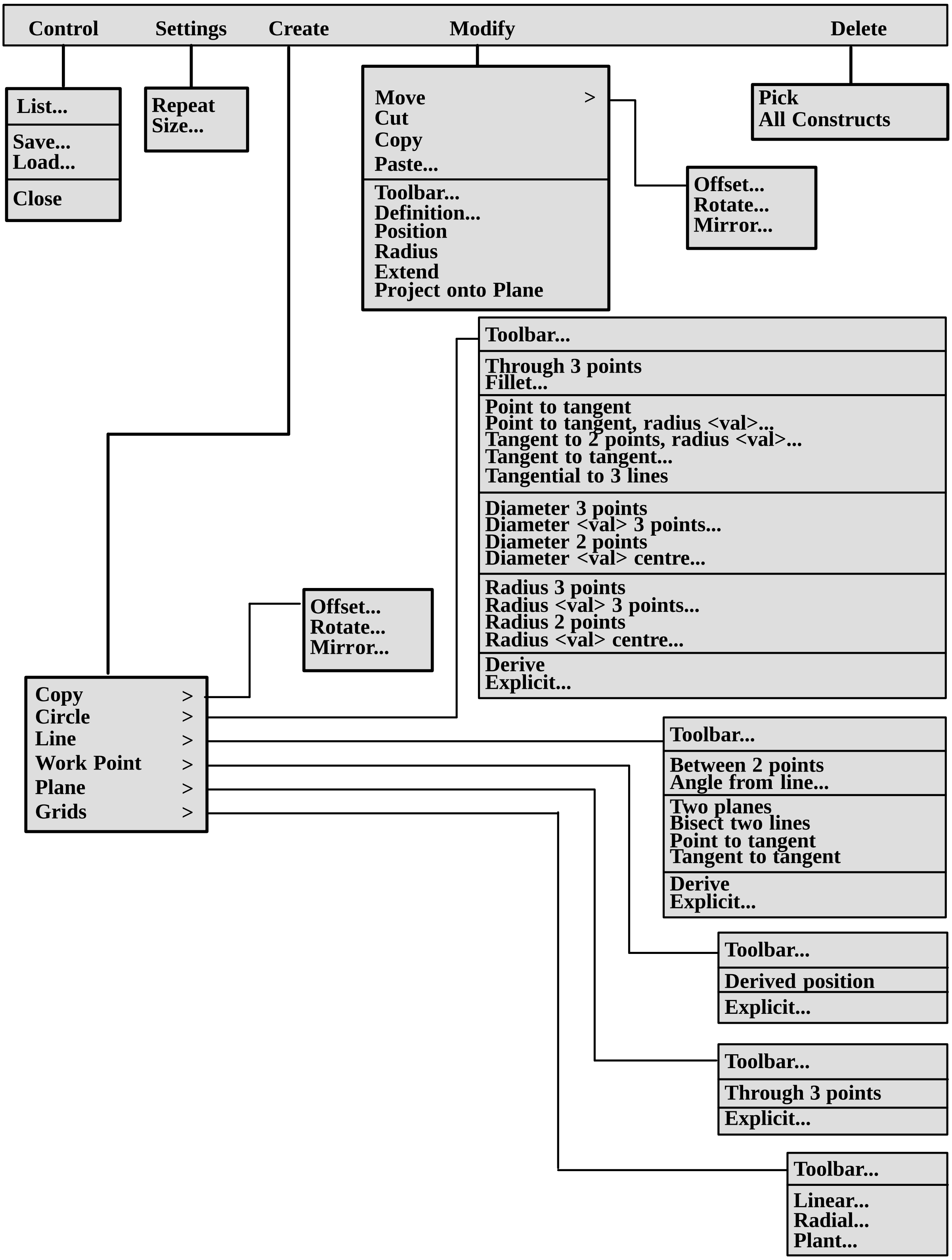

Window
Help
Members
3D View (1)
etc.
depending on
current
windows
On Context
Contents
Index
About

A.3 The *3D View* Menus (Right–Hand Mouse Button)

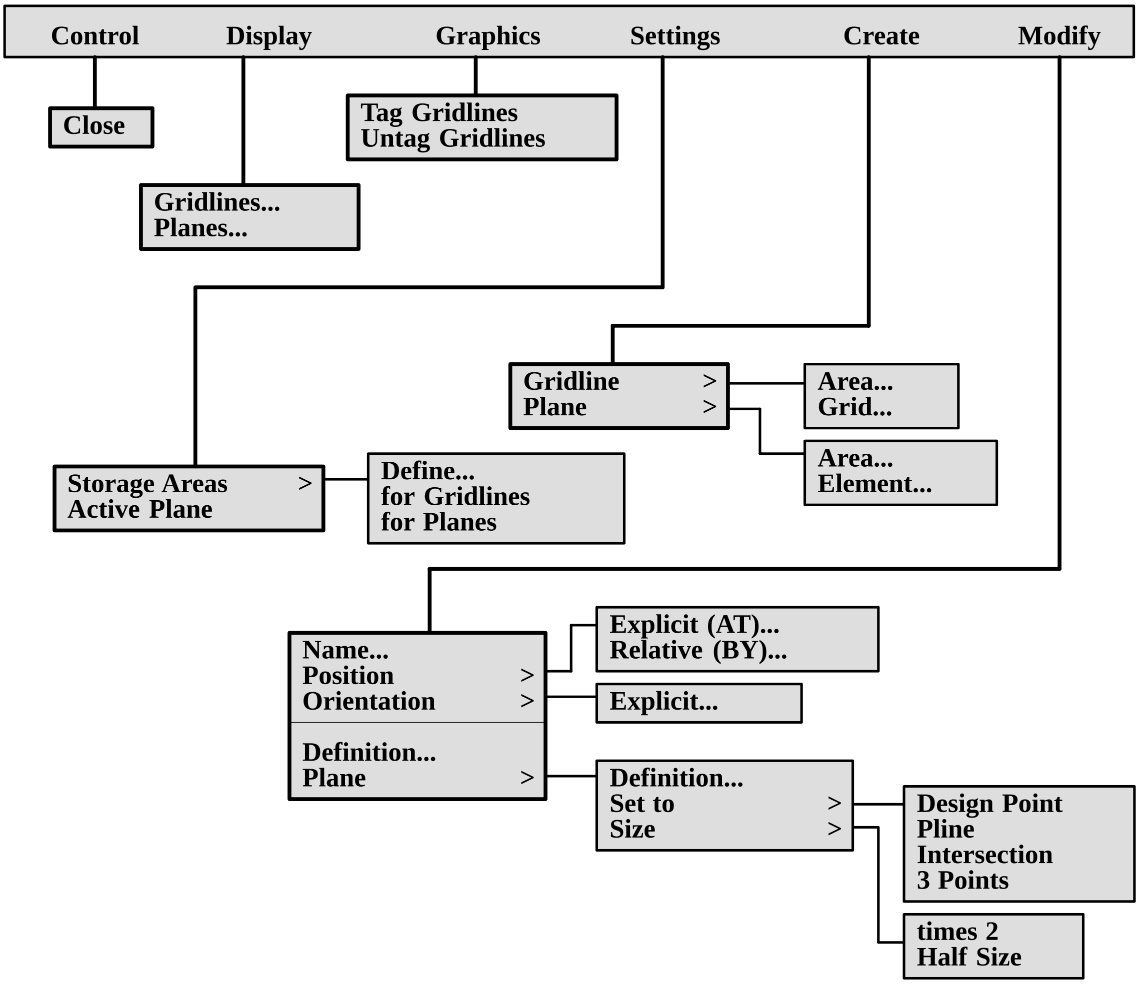


*Note: If **Settings>Long Menus** is Off, fewer options will be available.*

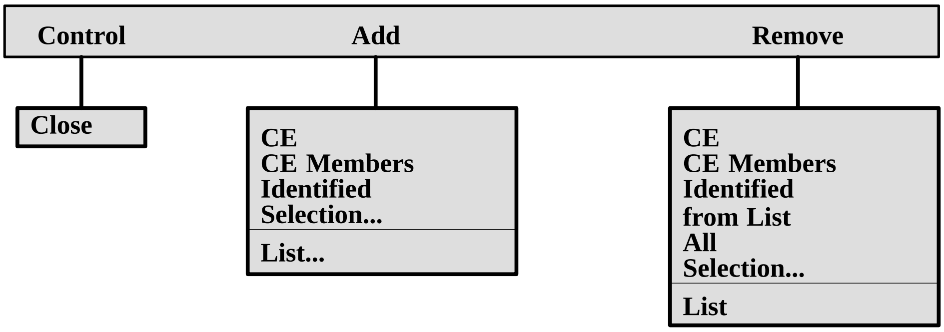
A.4 The *3D Aid Constructs* Menus



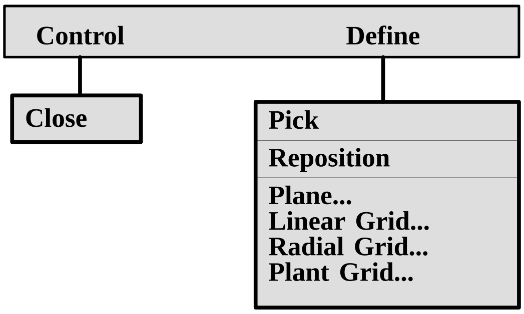
A.5 The *Reference Definition Application* Menus



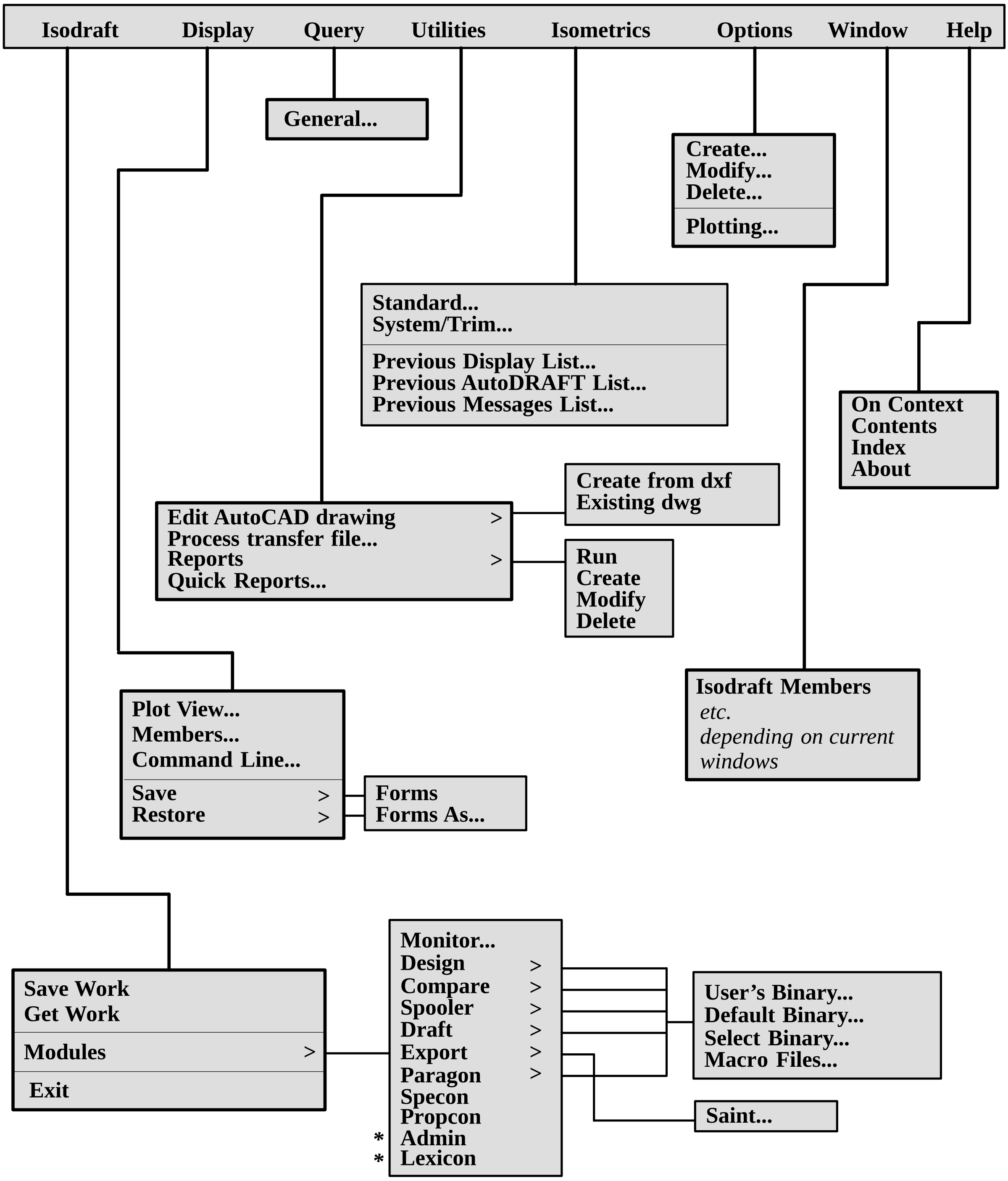
A.6 The *Lists/Collections* Menus



A.7 The *Working Plane* Menus



A.8 The ISODRAFT Menus



* *Note: These modules are available only if you are logged in as System Administrator.*

B The Equipment and Piping Design Database

The part of the Design database hierarchy which holds elements relevant to equipment and piping design is as follows (elements shown in italics, e.g. *BOX*, are Equipment items):

- **ZONE**
  - **PIPE** (PIPE)
    - **BRANCH** (BRAN)
      - **piping components**
        - **ATTACHMENT POINT (ATTA)**
        - **BEND (BEND)**
        - **BLIND FLANGE (FBLI)**
        - **CAP (CAP)**
        - **CLOSURE (CLOS)**
        - **COUPLING (COUP)**
        - **CROSS (CROS)**
        - **DUCTING (DUCT)**
        - **ELBOW (ELBO)**
        - **FILTER (FILT)**
        - **FIXED LENGTH TUBE (FTUB)**
        - **FLANGE (FLAN)**
        - **FOUR-WAY VALVE (VFWA)**
        - **GASKET (GASK)**
        - **GENERAL PIPE COMPONENT (PCOM)**
        - **INSTRUMENT (INST)**
        - **LAP-JOINT STUB END (LJSE)**
        - **OLET (OLET)**
        - **REDUCER (REDU)**
        - **STANDARD HOOK-UP (SHU)**
        - **TEE (TEE)**
        - **THREE-WAY VALVE (VTWA)**
        - **TRAP (TRAP)**
        - **UNION (UNIO)**
        - **VALVE (VALV)**
        - **VENT (VENT)**
        - **WELD (WELD)**
  - *EQUIPMENT ** *(EQUI)*
    - *SUBEQUIPMENT* *(SUBE)* — *optional*
      - ***NOZZLE*** *(NOZZ)*
      - *design primitives*
        - *BOX*
        - *CIRCULAR TORUS*
        - *CONE*
        - *CYLINDER*
        - *DISH*
        - *POLYHEDRON*
        - *PYRAMID*
        - *RECTANGULAR TORUS*
        - *SLOPE-BOTTOMED CYLINDER*
        - *SNOUT*

        (All primitive shapes have a negative equivalent which may be owned by a positive primitive)
      - *LOAD POINT* *(LOAP)*
  - ROUTING PLANE GROUP (RPLG)
    - ROUTING PLANE (RPLA)

* See also Section 5.1.2 for summary of use of Design Templates in this hierarchy

C Other Relevant Documentation

This guide is intended only as an introduction to those parts of PDMS most relevant to pipework design. As such, it describes only the main concepts needed to get you started. Should you need more detailed information about any topic, the following documents are available.

C.1 On–Line Help

For detailed instructions on the use of the forms and menus via which you control the application, on–line help is provided as an integral part of the user interface.

The **Help** option on the menu bars gives you the following choices:

Help>on Context

This gives you help on *any* window currently visible in the display. When you select this option, the cursor changes to a question mark (**?**). Move the question mark into the window on which you want help and click the left–hand mouse button.

Help>Contents

This displays the Help window so that you can find the required topic from the hierarchical contents list.

Help>Index

This displays the Help window so that you can find all topics relevant to a selected keyword.

Help>About

This displays information about the current operating system on your computer and about the versions of PDMS and its applications to which you have access.

Pressing the **F1** key at any time will display the help topic for the currently active window (equivalent to Help on Context for the current window).

C.2 PDMS Application User Guides

The full PDMS documentation set includes a number of user guides which explain how to use those applications for which on–line help is not yet available.

Relevant guides in this series are:

DRAFT Application User Guide

C.3 PDMS Reference Manuals

The full PDMS documentation set includes a number of reference manuals which give detailed explanations of all the technical concepts involved. These manuals also describe the underlying command syntax which can be used to control PDMS directly (thus bypassing the forms and menus interface).

Those particularly relevant to piping design work include:

DESIGN Reference Manual	Covers concepts and commands for all design disciplines.
ISODRAFT Reference Manual	Explains how to create customised piping isometric plots.
DRAFT Reference Manual	Explains the PDMS 2D drafting facilities.
PARAGON Reference Manual	Explains how to set up a PDMS Catalogue.
SPECON Reference Manual	Explains how to create tabulated specifications.

C.4 General Guides

The following guides are intended for use only by experienced PDMS users who want to write their own applications:

Cadcentre Software Customisation Guide

Explains how to write your own application macros using PML (Cadcentre's Programmable Macro Language) and how to design your own forms and menus interface.

Cadcentre Software Customisation Reference Manual

Supplements the *Customisation Guide*. Includes a list of PML 2 Objects, Members and Methods. For Forms and Menus objects, the command syntax relating to the objects is included.

D Some Sample Plots

This appendix comprises some examples of typical (though relatively simple) plots showing the sorts of piping design outputs which may be created using PDMS with the CADCENTRE pipework application.

| FABRICATION MATERIALS |

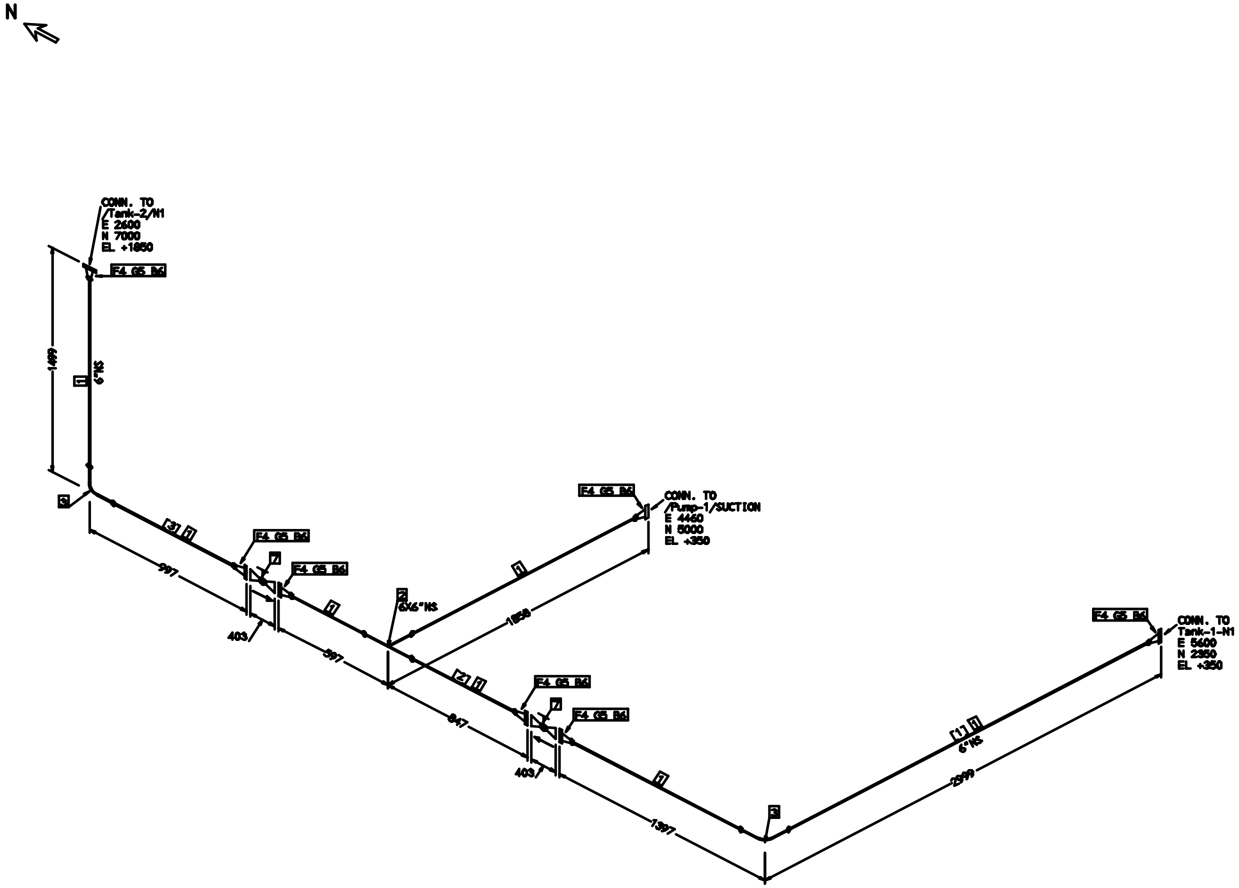
PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	PIPE			
1	PIPE SCH40 ANSI B36.10 API 5L-B	6	PA150	8.2M
	FITTINGS			
2	TEE ANSI B16.9 BW ASTM A234-WPB	6 x 6	TA150	1
3	ELBOW LR ANSI B16.9 BW ASTM A234-WPB	6	EA150	2
	FLANGES			
4	FLANGE WN ANSI B16.5 #300.RF ASTM A105	6	FWD150	7

| ERECTION MATERIALS |

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	GASKETS			
5	GASKET RF 1.5MM ANSI B16.5 #300 SS & ASB	6	GC150	7
	BOLTS			
6	120 STUD CW 2 NUTS ASTM A193-B7/2H	13/16	SBDR120	84
	VALVES / IN-LINE ITEMS			
7	VALVE GATE ANSI B16.10 #300.RF ASTM A216-WCB	6	VG150	2

PIPE SPOOLS

[1] [2] [3]



PIPE NS (INS) 6
CL LENGTH 11.1

[1] DENOTES PIPE SPOOL NO
[1] DENOTES PARTS LIST NO

SHOP WELD | FIELD WELD | SOCKET WELD | SCREWED JOINT | COMPN JOINT | SITE CONNECTION | PIPE SUPPORT | LAGGED PIPE | TRACED PIPE

DATE: 01 FEB 96
BATCH REF: PIPEZONE
PIPING SPEC: A3B | ISS: -1

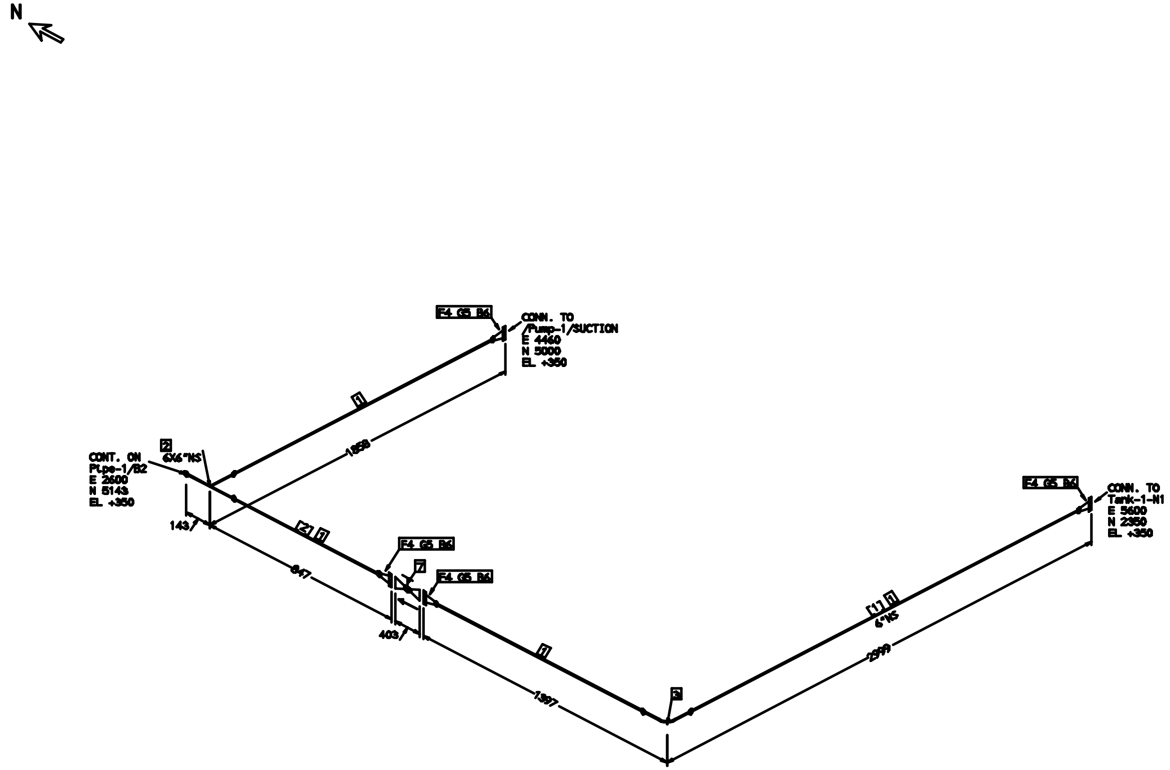
Pipe-1

| FABRICATION MATERIALS |

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	PIPE			
1	PIPE SCH40 ANSI B36.10 API 5L-B	6	PA150	6.0M
	FITTINGS			
2	TEE ANSI B16.9 BW ASTM A234-WPB	6 x 6	TA150	1
3	ELBOW LR ANSI B16.9 BW ASTM A234-WPB	6	EA150	1
	FLANGES			
4	FLANGE WN ANSI B16.5 #300.RF ASTM A105	6	FWD150	4

| ERECTION MATERIALS |

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	GASKETS			
5	GASKET RF 1.5MM ANSI B16.5 #300 SS & ASB	6	GC150	4
	BOLTS			
6	120 STUD CW 2 NUTS ASTM A193-B7/2H	13/16	SBDR120	48
	VALVES / IN-LINE ITEMS			
7	VALVE GATE ANSI B16.10 #300.RF ASTM A216-WCB	6	VG150	1
	PIPE SPOOLS			
	[1] [2]			



PIPE NS (INS) 6
CL LENGTH 7.7

[1] DENOTES PIPE SPOOL NO
[1] DENOTES PARTS LIST NO

SHOP WELD | FIELD WELD | SOCKET WELD | SCREWED JOINT | COMPN JOINT | SITE CONNECTION | PIPE SUPPORT | LAGGED PIPE | TRACED PIPE

DATE: 01 FEB 96
BATCH REF: PIPEZONE
PIPING SPEC: A3B | ISS: -1

Pipe-1/B1

| FABRICATION MATERIALS |

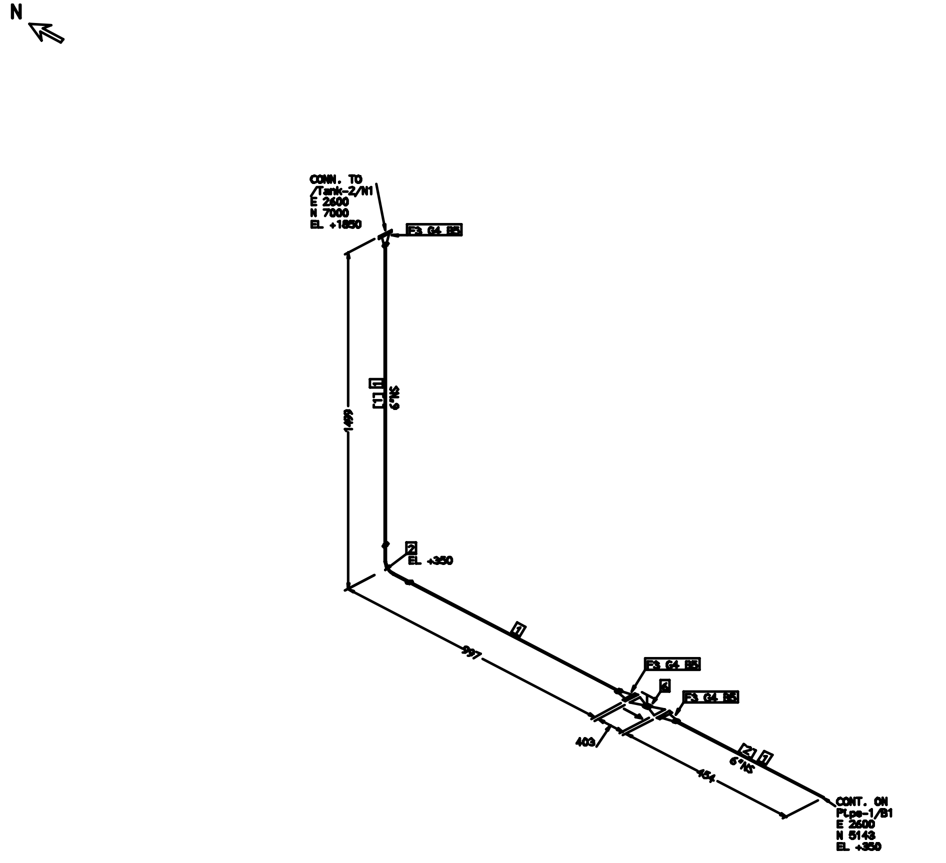
PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	PIPE			
1	PIPE SCH40 ANSI B36.10 API 5L-B	6	PA150	2.2M
	FITTINGS			
2	ELBOW LR ANSI B16.9 BW ASTM A234-WPB	6	EA150	1
	FLANGES			
3	FLANGE WN ANSI B16.5 #300.RF ASTM A105	6	FWD150	3

| ERECTION MATERIALS |

PT NO	COMPONENT DESCRIPTION	N.S. (INS)	ITEM CODE	QTY
	GASKETS			
4	GASKET RF 1.5MM ANSI B16.5 #300 SS & ASB	6	GC150	3
	BOLTS			
5	120 STUD CW 2 NUTS ASTM A193-B7/2H	13/16	SBDR120	36
	VALVES / IN-LINE ITEMS			
6	VALVE GATE ANSI B16.10 #300.RF ASTM A216-WCB	6	VG150	1

PIPE SPOOLS

[1] [2]



PIPE NS (INS) 6
CL LENGTH 3.4

[1] DENOTES PIPE SPOOL NO
DENOTES PARTS LIST NO

SHOP WELD	FIELD WELD	SOCKET WELD	SCREWED JOINT	COMPN JOINT	SITE CONNECTION	PIPE SUPPORT	LAGGED PIPE	TRACED PIPE

DATE: 01 FEB 96
BATCH REF: PIPEZONE
PIPING SPEC: A3B | ISS: -1
PIpe-1/B2

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