Pro/Piping:

The basics of getting started

Table of Contents:

Objective:

At the end of this tutorial, you will be able to:

- Create and modify basic piping assemblies using Pro/Piping.
- List three methods to route pipes.
- Define two methods to insert fittings.
- Explain three benefits of creating assemblies using Pro/Piping.

Benefits:

- Pro/Piping allows 100% accurate capture of the complex pipe routing in assemblies.
- Documentation is intelligent and complete for the assembly floor.
- Purchasing is able to accurately forecast material orders because drawings report the up to date and accurate pipe lengths (for the entire assembly)!
- Clearance and interference checks are accurate because the complete assembly is represented.

Overview:

Many products contain more than just mechanical components, quite often fluid, gas, and electrical systems are present and Pro/Engineer has a suite of fully integrated tools that can automate and optimize the creation of these components.

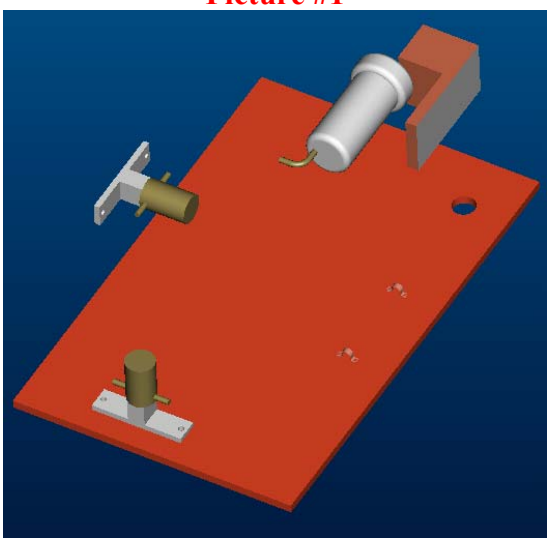
Our focus for this tutorial will be the routing of flexible and rigid pipes using Pro/Piping. We'll start by setting up the initial piping environment, then create some rigid pipes, we'll create some flexible pipes, and finally add in any necessary fittings (elbows, reducers, etc.). At the end of this, you can even create a complete assembly bill of material with project costs and 100% accurate pipe length information!

Note: since the selection method of using the "Right Mouse Button" comes up so frequently, it will be referred to simply as RMB from this point on.

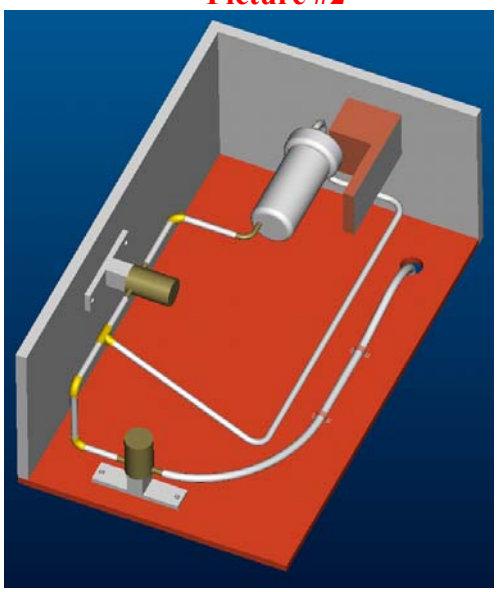
Tutorial:

Picture #1 shows an example of a typical fluid system inside of an enclosure containing some pumps and valves. Although fairly basic, it'll provide us a chance to try out several different methods of creating pipes and connections. When you first open the assembly "TOP_LEVEL", I recommend using the hide command on the gray walls to simplify the display. Simply select the parts, then RMB, HIDE.

Picture #1



Picture #2



We're going to route a few different types of pipes and connectors and end up with this!

Step 1: Setup the piping environment by creating a rigid line stock:

a) Open the assembly, TOP_LEVEL, and "HIDE" the gray walls.
b) On the top menu, select APPLICATIONS, PIPING
c) On the right side menu, select SETUP, LINE STOCK, CREATE
d) Enter the name for the first pipe (a rigid pipe) as PVC.
e) Enter the required information into the LINE STOCK dialogue box as shown:

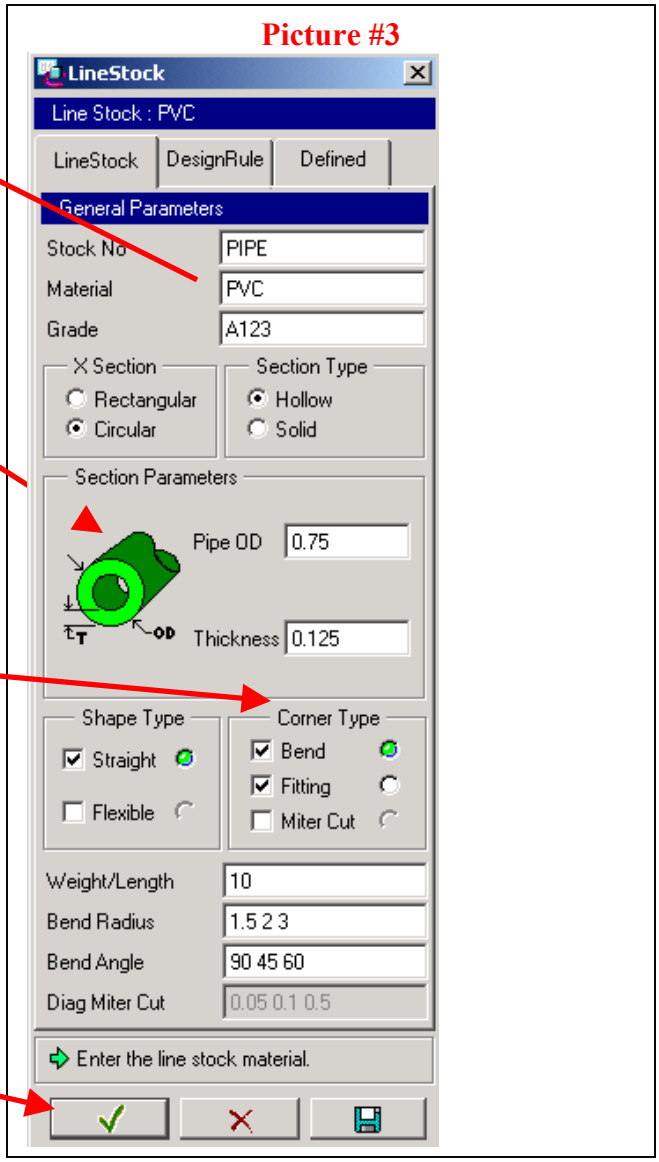
Enter the material and grade of the pipe.

Enter size information for the pipe as shown.

Specify what type of corners you'll allow. Fitting creates 90° bends (for fittings) and bend creates smooth radius corners. One pipe can be routed as either if both are checked.

Check box when done.

Picture #3



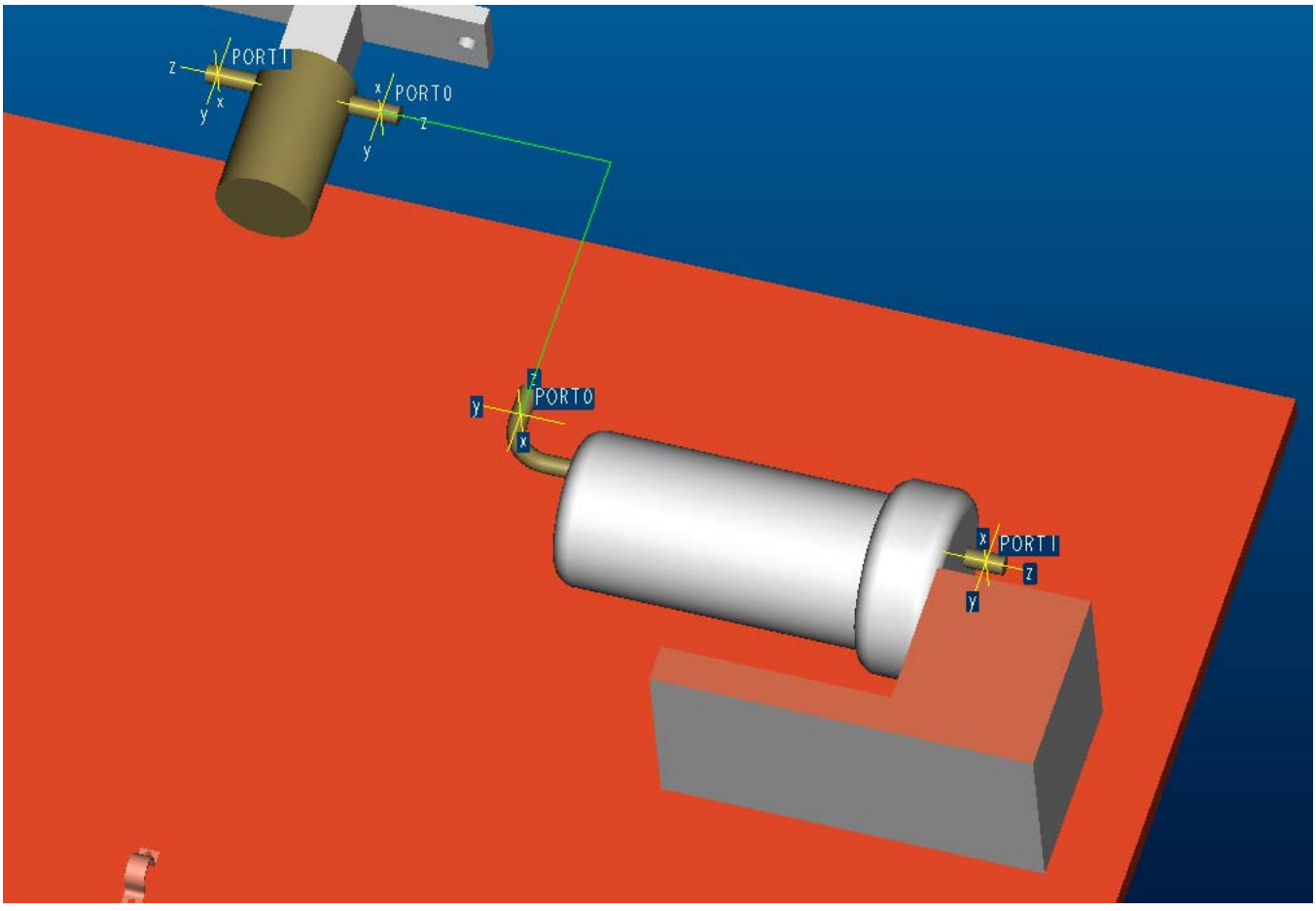
Step 2: Create a flexible line stock.

a) On the right side menu, select SETUP, LINE STOCK, CREATE
b) Enter the name for the first pipe (a rigid pipe) as HOSE
c) Enter the required information into the LINE STOCK dialogue box as shown:
    a. Material = Plastic
    b. Pipe OD = .75
    c. Thickness = .125
    d. Shape Type = Flexible

Step 3: Now we're going to route our first rigid pipe using a simple "Connect":

a) On the right side menu, select PIPELINE, CREATE/ROUTE
b) Enter a name for this line, "Line1", enter
c) Select the line stock to use, "PVC"
d) Now we're in the "Route Pipe" menu, we'll simply "Connect" two ports.
e) Select CONNECT and pick the two ports shown below.
f) Select DONE CONNECT and DONE/RETURN to finish this pipe segment (Picture #4).

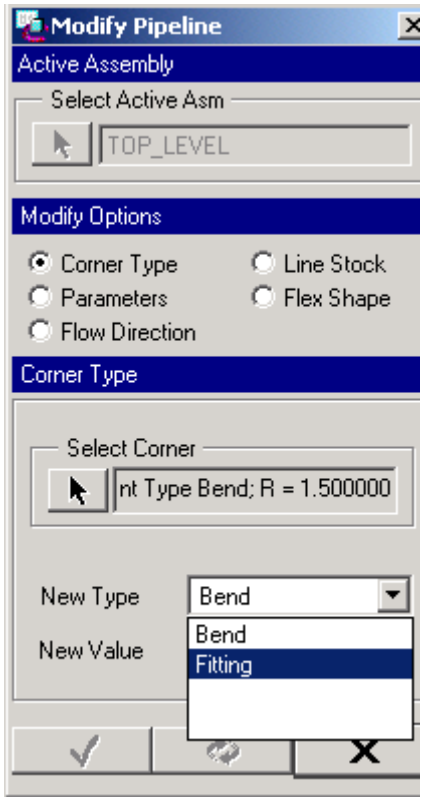
Picture #4



Step 4: Change the corner type of a pipe:
We didn't change the default bend type so our pipeline was created with a radius at the bend. We want to insert in 90° elbows there so we'll change the corner type.

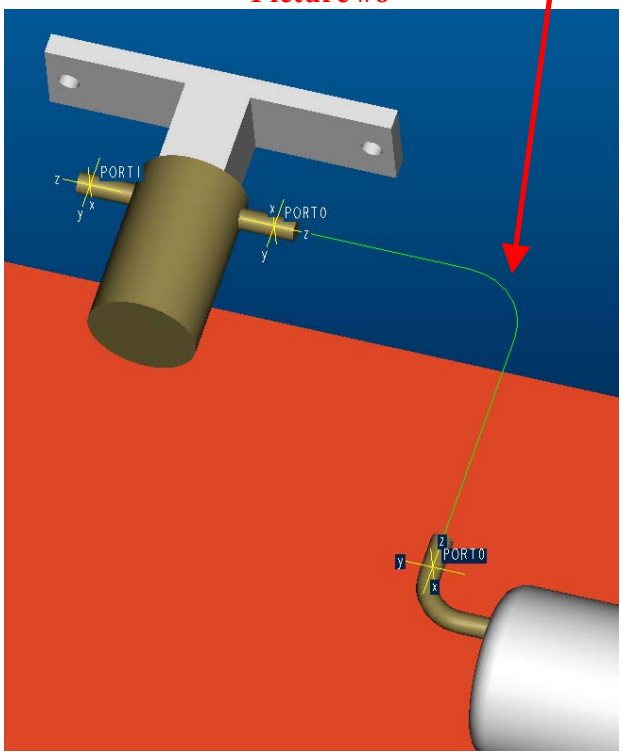
a) On the main menu, select MODIFY PIPE and you'll see a dialog box (Picture #5)
b) Pick the corner where the radius is, DONE SEL, change the drop down box to "Fitting" and then select the check box (Picture #6)

Picture #5



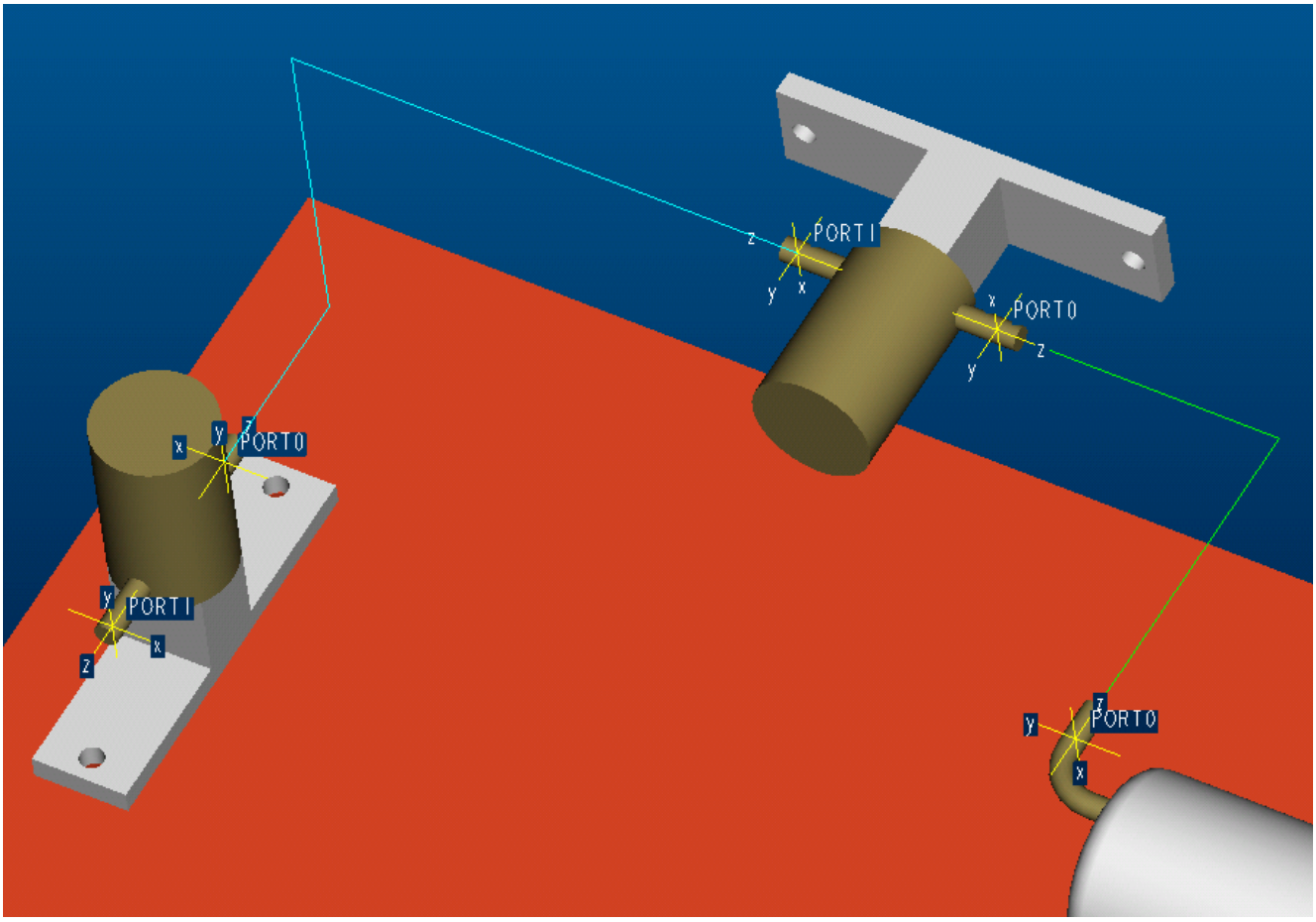
Select this corner and change to a "Fitting" which is a 90° corner.

Picture #6



Step 5: Create another pipe line and modify the

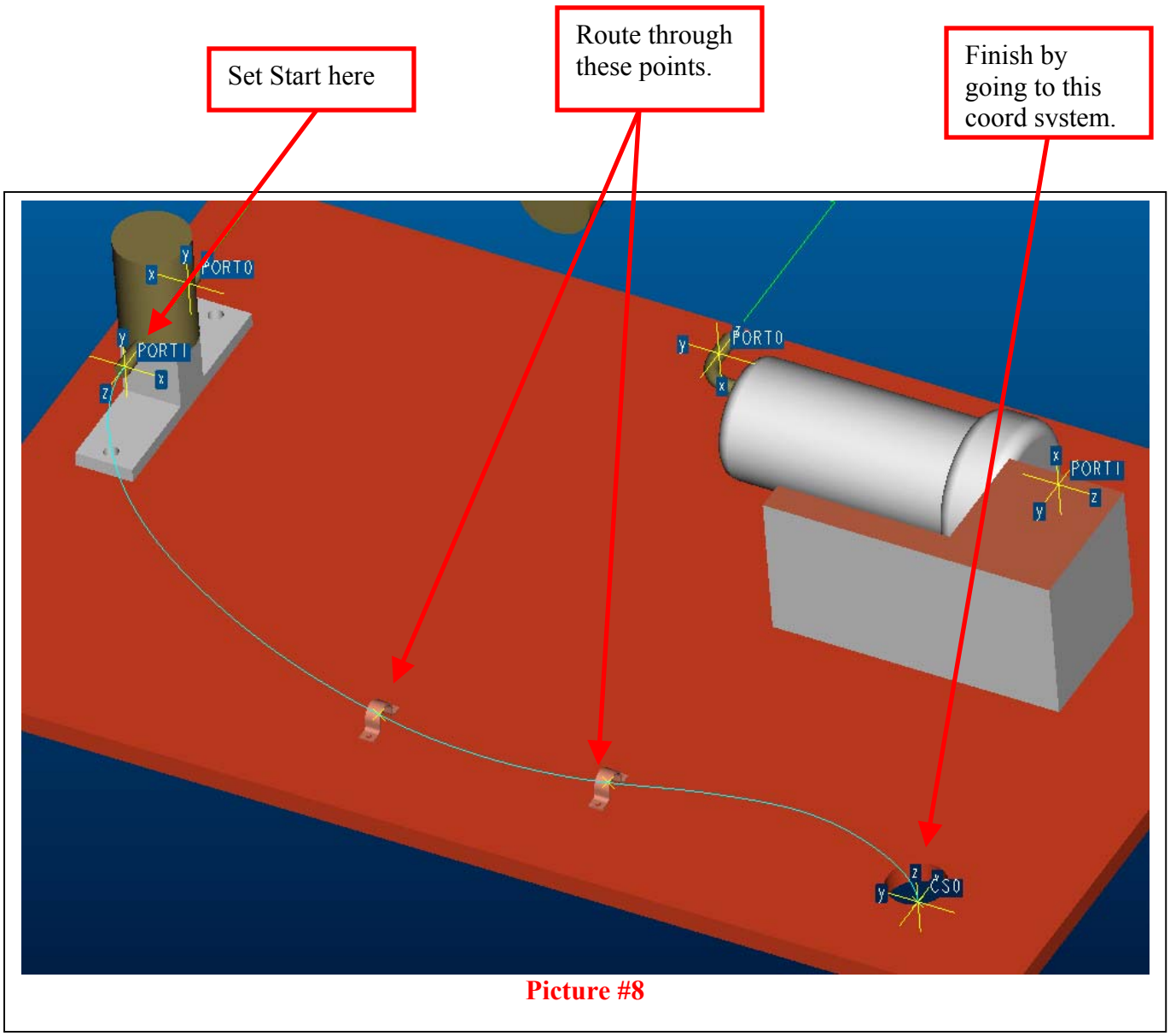
a) On the right side menu, select PIPELINE, CREATE/ROUTE
b) Enter a name for this line, “Line2”, enter
c) Select the line stock to use, “PVC”
d) Now we want to change the corner type before we start routing. Select PIPE ENVRNMT, CORNER TYPE, FITTING, DONE.
e) Now simply connect the ports like the last line.
f) Select CONNECT and pick the two ports shown below.
g) Select DONE CONNECT and DONE/RETURN to finish this pipe segment (Picture #7).



Picture #7

Step 6: Create and route a flexible hose:

a) Do the same steps to create a new pipe line, except pick the flexible "Hose" line you had created earlier for the line stock.
b) Now set your starting position by selecting SET START and pick the coordinate system on the valve.
c) Now we'll route through points in the middle of the clips by selecting TO PNT/PORT and picking the two points.
d) To finish the routing, pick the coordinate system going through the hole.
e) You'll see a best-fit spline through those points as shown in Picture #8. The spline shape can be edited if necessary by selecting INSERT POINT, picking somewhere on the pipeline and then dragging the points.

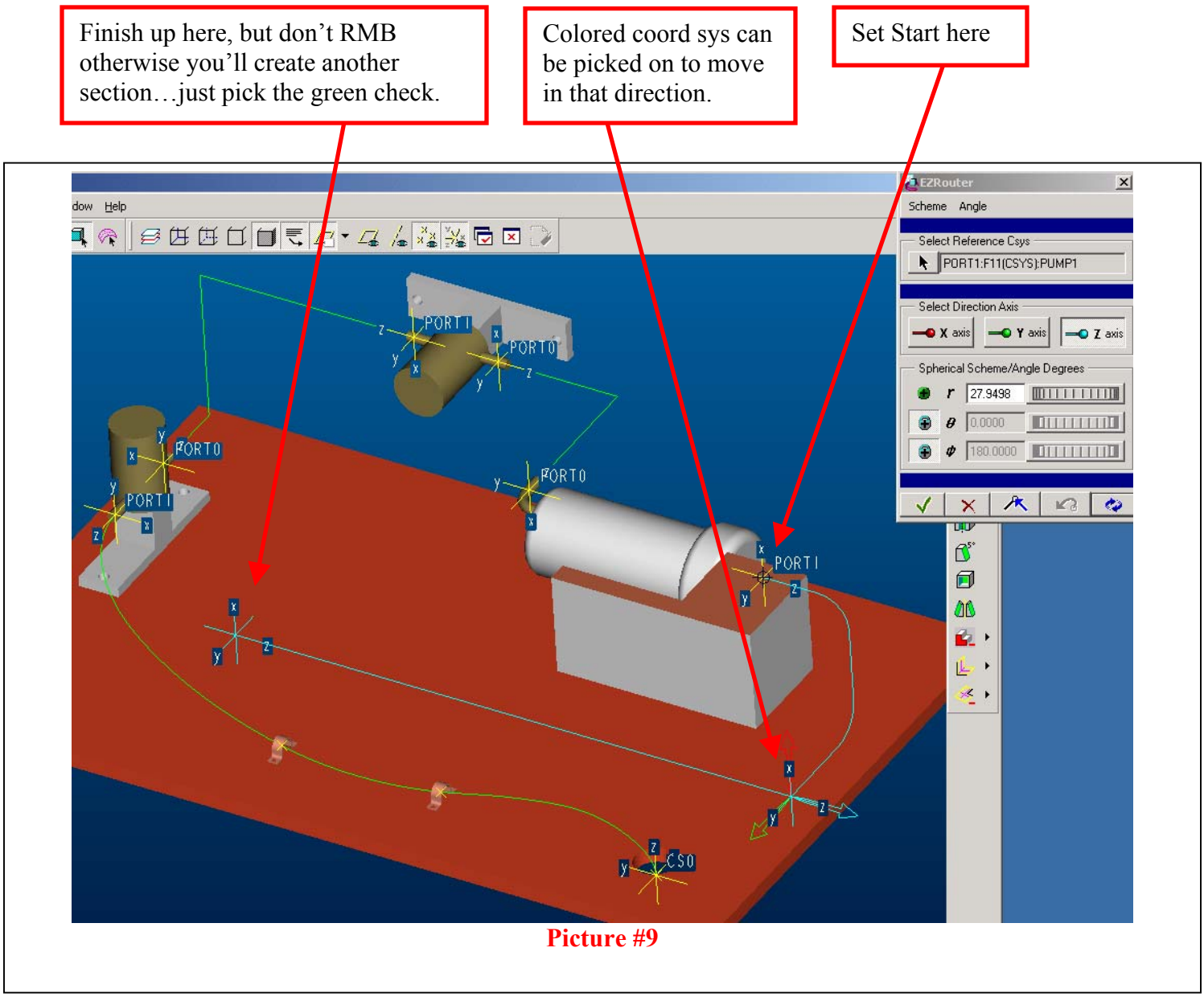


Picture #8

Title: Pro/Piping, the basics of getting started	
Date: 1/6/03	
Version: Pro/Engineer 2001	

Step 7: Use the "Easy Router" to click and drag pipes:

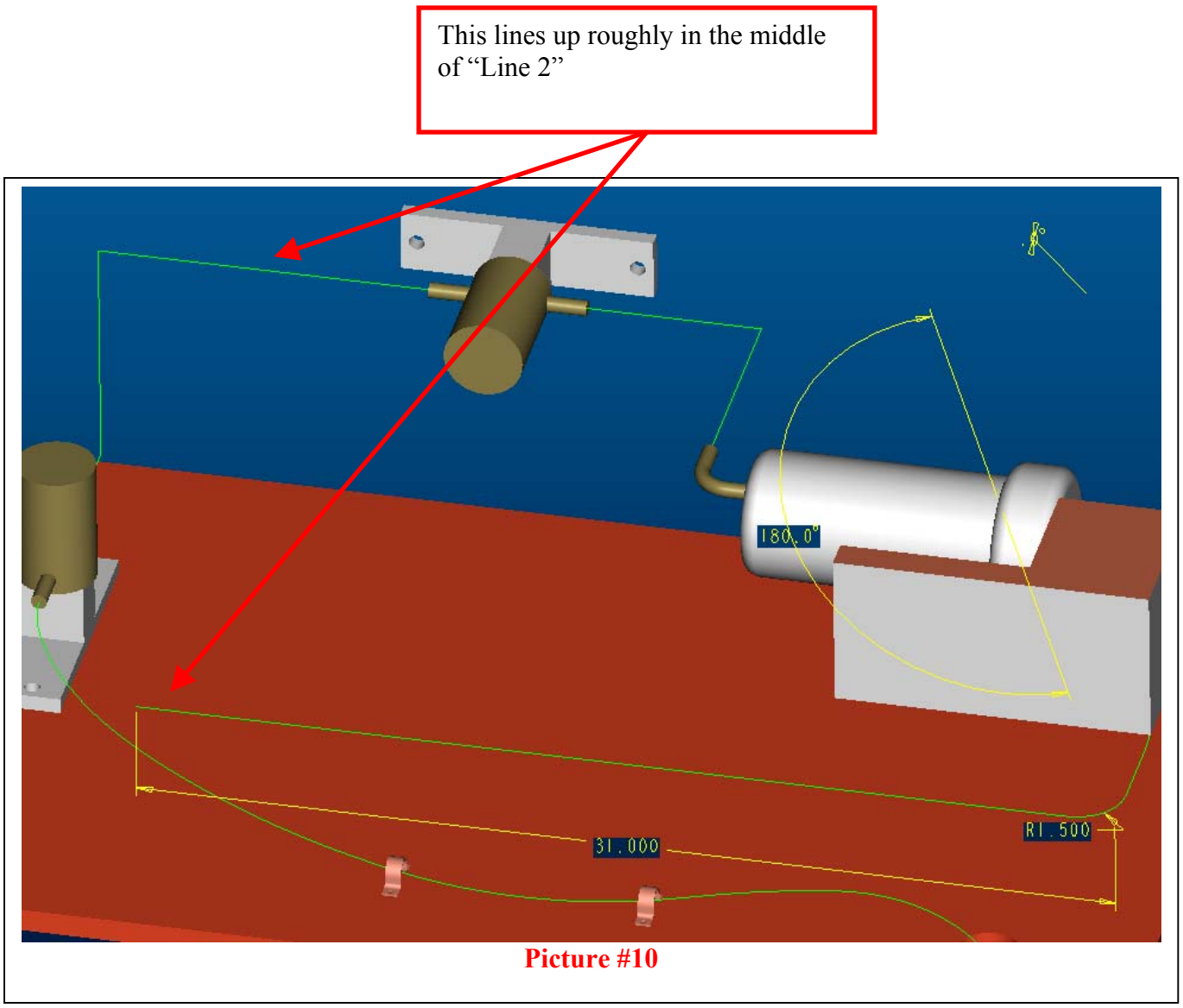
a) Do the same steps to create a new pipe line, except pick the "PVC" line you had created earlier for the line stock.
b) Select SET START and pick the coordinate system on the back of the pump.
c) Select EZROUTER and you'll be presented with a colored coordinate system that allows you to interactively pick on an arrow and drag the pipe in that direction. You'll notice the length of the pipe updating in the dialog box (Picture #9) and you can set it's location by picking the left mouse button…to accept that position, hit the right mouse button.
d) Now you can use the coordinate system interactively and build your pipe around obstacles very easily. Don't worry about the lengths right now; we can modify those at any time simply by double clicking on the pipeline.
e) For your last segment (long one running lengthwise below the pump) use the left mouse to select the location, but do not RMB, instead just select check box.



Picture #9

Step 8: Modify the pipe length so it's lined up:

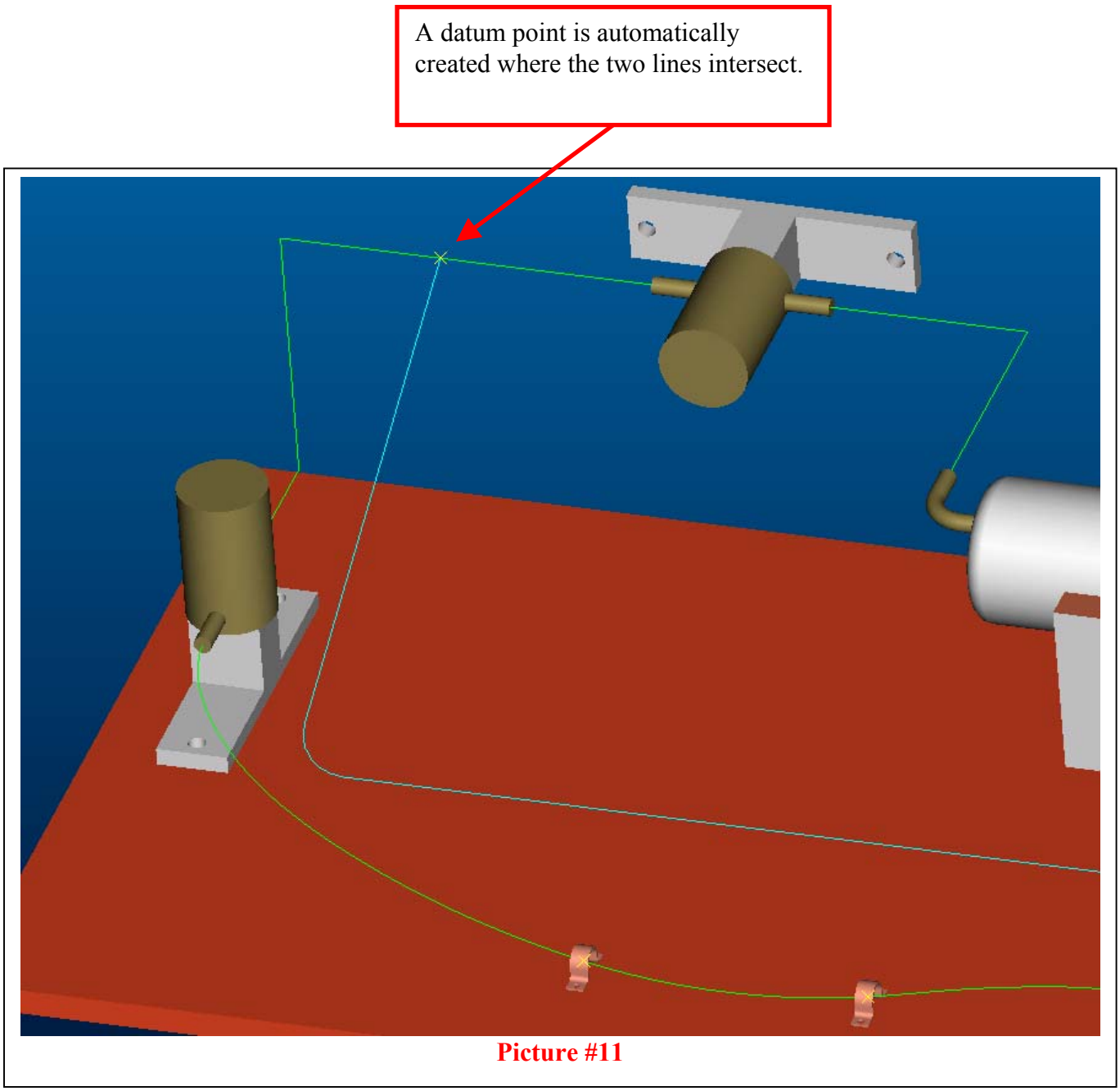
a) Make sure the line extends to roughly the middle of "Line 2", Picture #10.



Picture #10

Step 9: Now create a "T" branch up to the existing "Line 2":

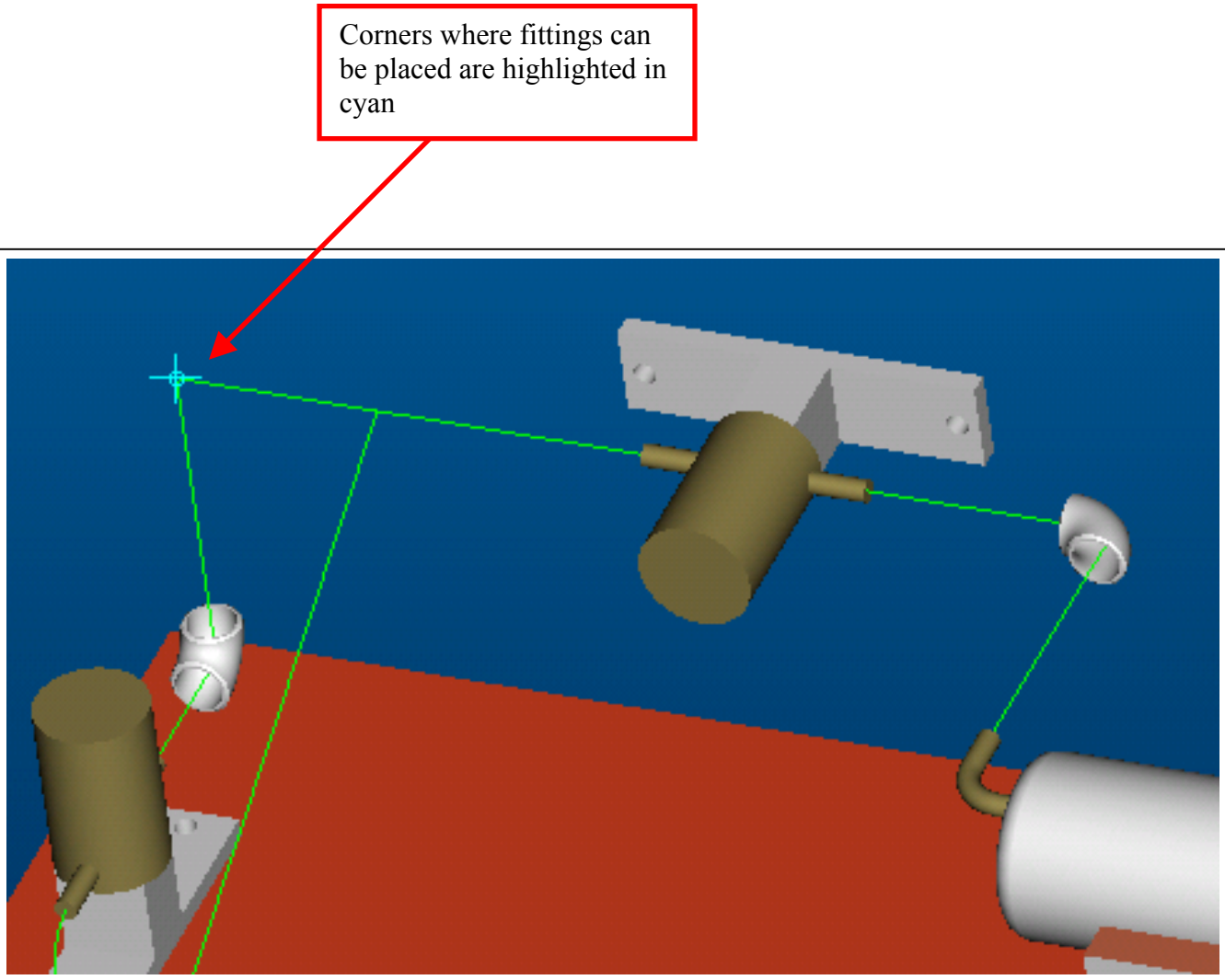
a) Select ROUTE, and pick "Line 3"
b) Select BRANCH, PERPINDICULAR and it will connect the lines together with a perpendicular branch (Picture #11)



Picture #11

Step 10: It's time to place our fittings!

a) On the main menu, select FITTINGS, INSERT, CORNER
b) A window pops up so you can select the fitting, but notice in the model that all of the corners where a fitting can be placed highlight in cyan.
c) In the dialog box, choose the"90_elbow" part and pick one of the corners, DONE
d) Do these two more times and place all three elbows in (Picture #12). Also notice that "Line 3" doesn't give you the option to place fittings because its corner types are "bend".
e) Tip: when I have to place a lot of elbows I create a mapkey so all I have to choose is the corner where it goes.



Picture #12

Step 11: It's time to place our fittings!

a) On the main menu, select FITTINGS, INSERT, CORNER
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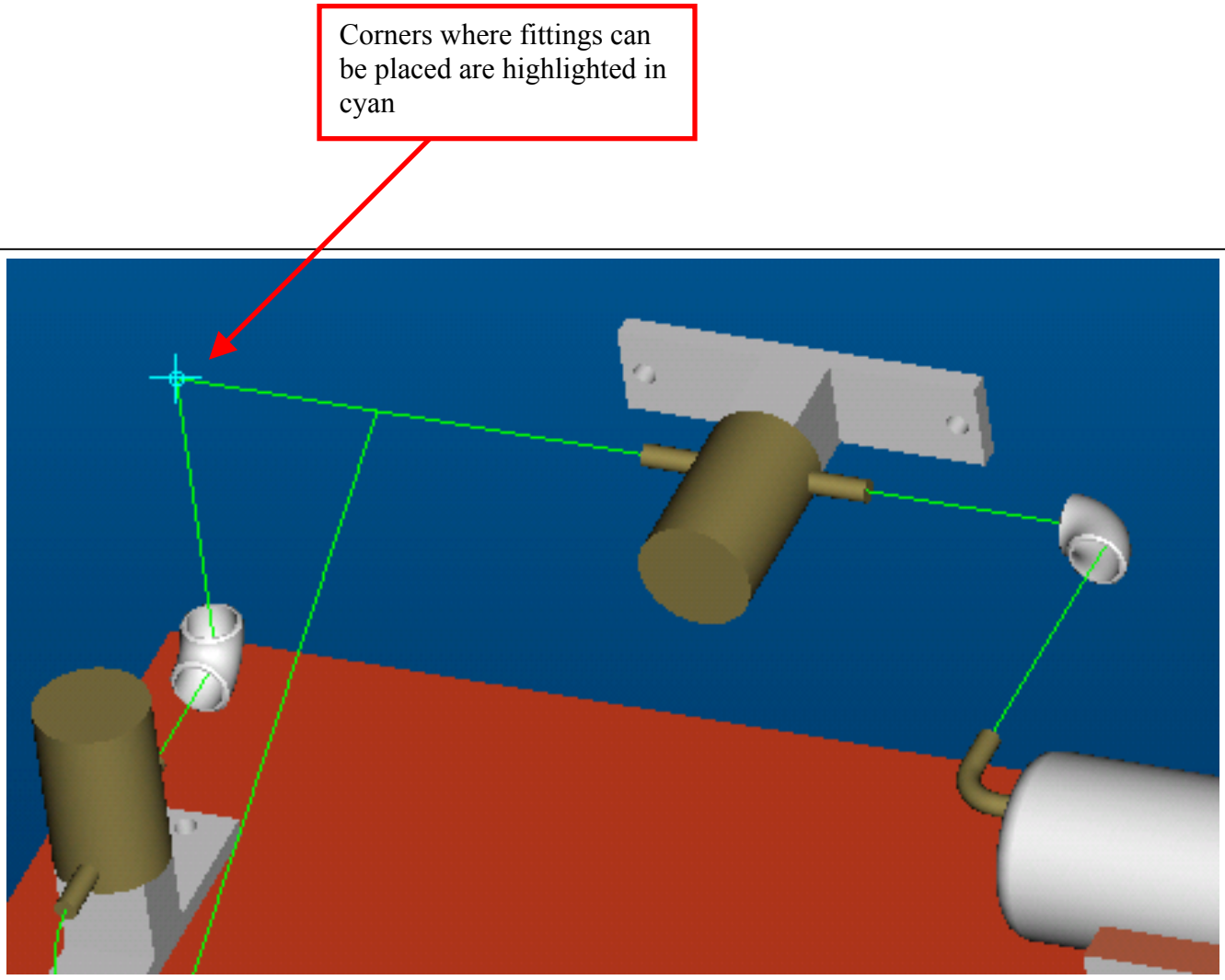


Picture #13

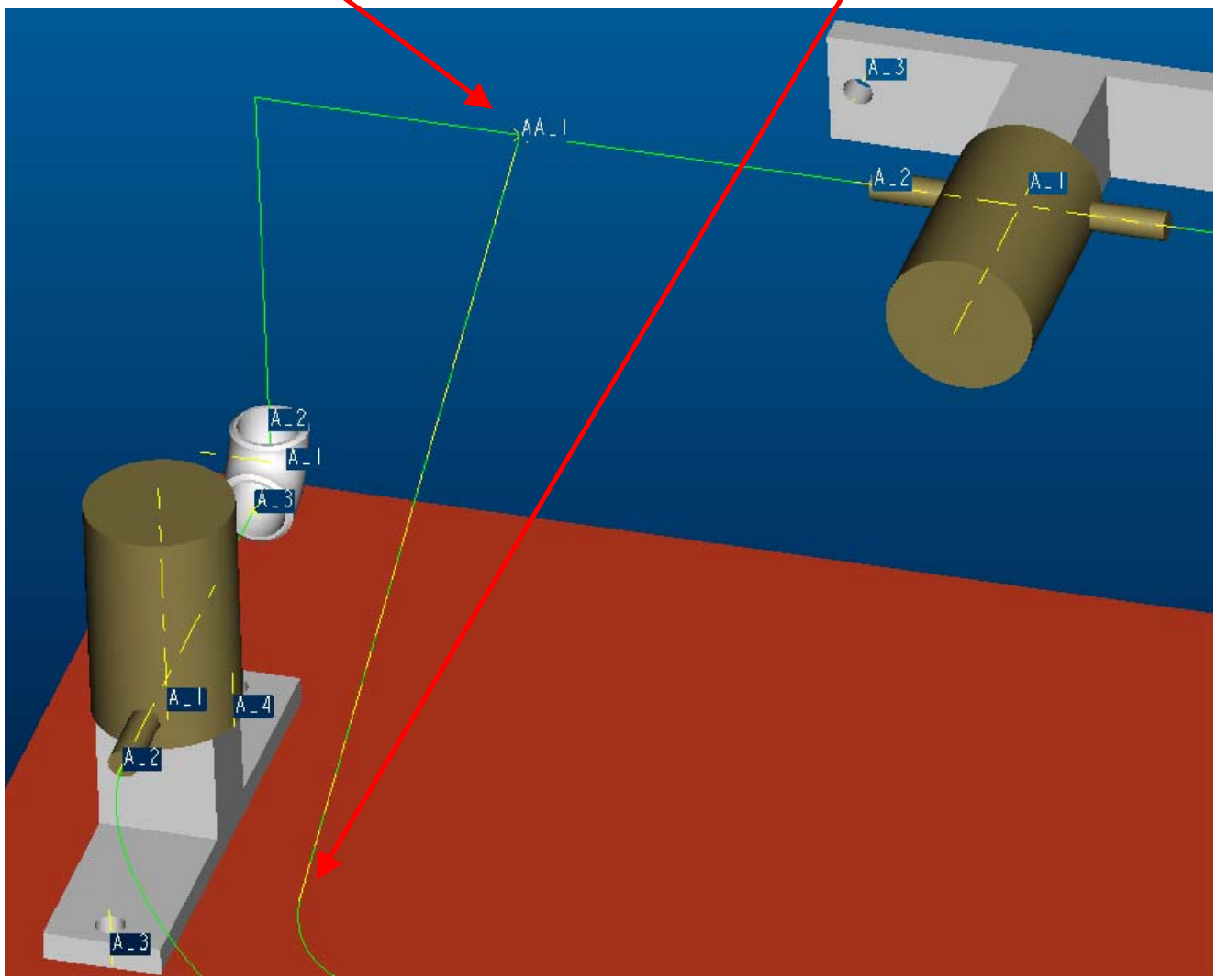
Step 12: Create a datum axis to align our "T" fitting to.

a) First we need to place an axis along "Line 3" so we'll have something to align our "T" fitting to. On the top menu bar, select INSERT, DATUM, AXIS, TWO PNT/VTX.

b) Pick the datum point created at the perpendicular joint for the first point, then query select the bottom of that pipe length to get the end of the curve (Picture #14)

Create a datum axis through two points. Pick perpendicular intersection for first point.

Query select to get the second point on the end of the pipeline.



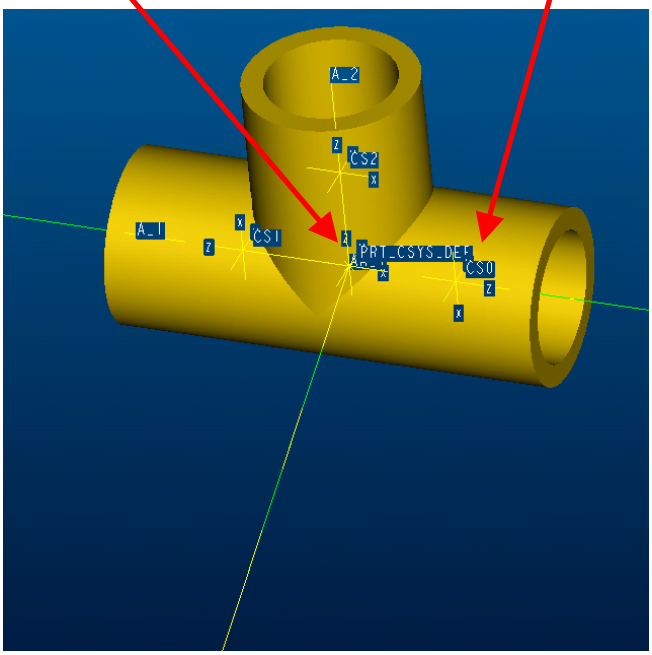
Picture #14

Step 13: Let's place the "T" fitting and break "Line 2" into two pieces.

a) On the main menu, select FITTINGS, INSERT, STRAIGHT BRK
b) A window pops up so you can select the fitting, pick "t-fitting".
c) On right side menu, choose SELECT PNT instead of creating on, then pick on the datum point at the intersection of the two lines.
d) The "t-fitting" model will come up in a separate window, pick the coordinate system on the right side to align it's orientation, then select the datum point in the middle of the "T" to locate it on the assembly datum point (Picture #15).
e) Now we need to orient the fitting along the pipe axis. Select ORIENTATION, TWIST, ALIGN X, and pick the axis going through the pipe line (Picture #16), then OKAY. If you get the direction180° wrong, simply select FLIP after you choose the axis.
f) Just "DONE" out of all the menus and your finished!

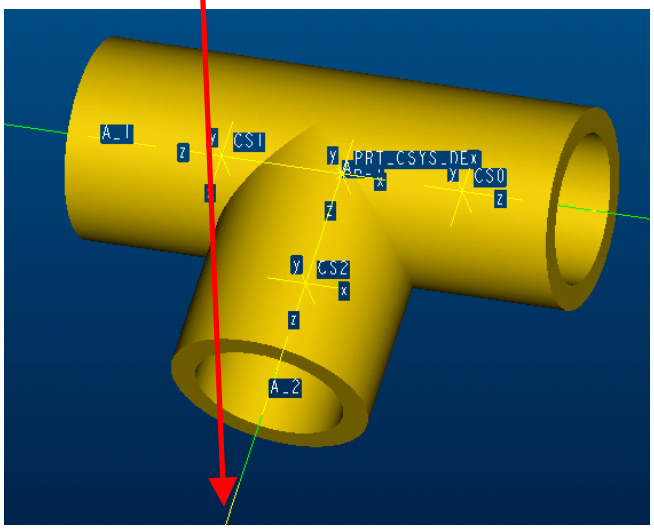
Pick the datum point at the center of the part to locate the "T" at the intersection.

Pick this coord sys to set the initial orientation.



Picture #15

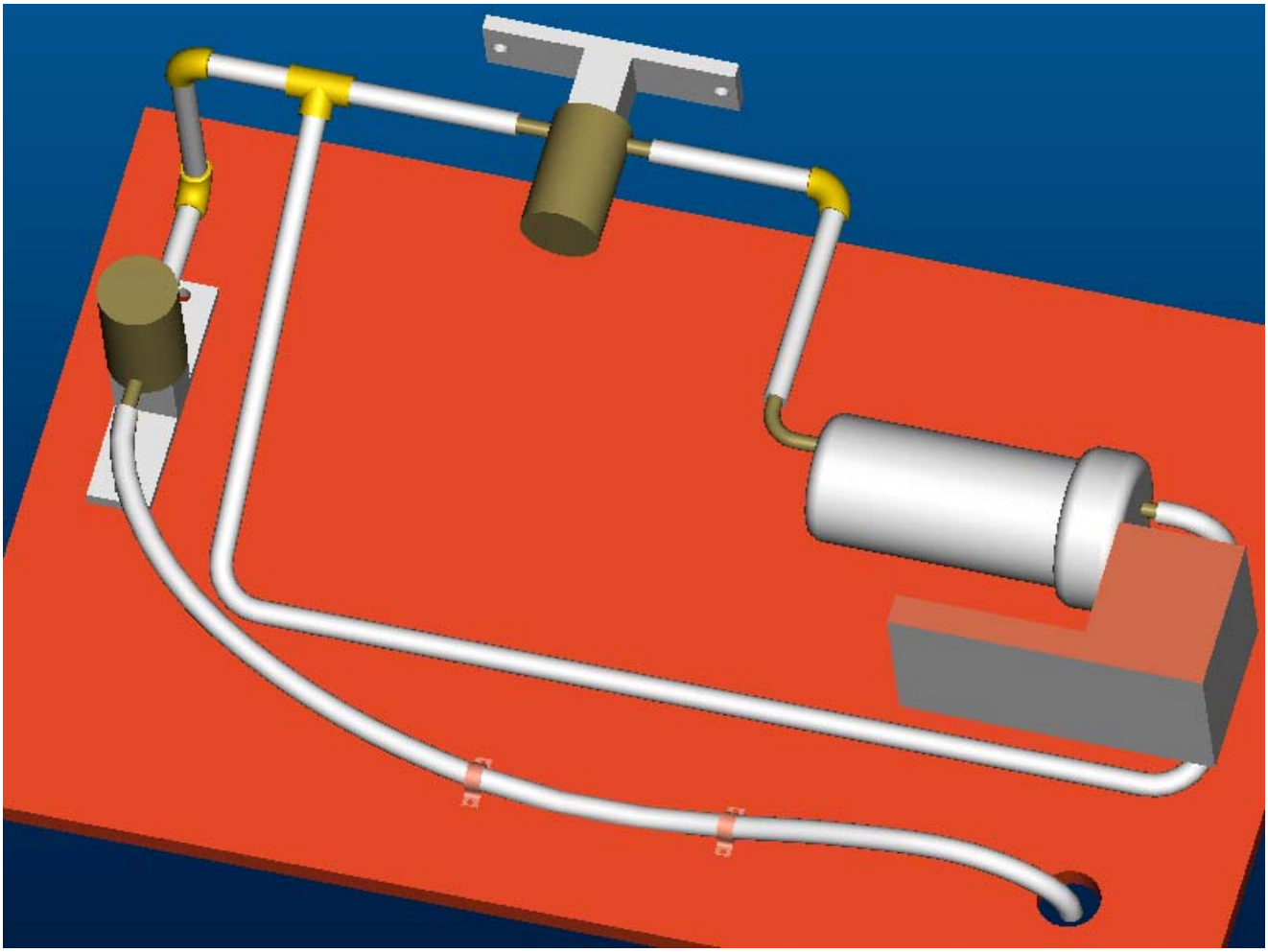
Pick the pipeline datum axis to orient the x-axis of the fitting (flip if necessary).



Picture #16

Step 14: You're done! You've completed your first Pro/Piping assembly!

1) You're model should look something like Picture #17.



Picture #17

Step 15: Optional. Create intelligent drawings using the included drawing format.
a) Filters are set up in the repeat regions so you'll want to edit them to accommodate any additional parts you'd like to filter out. See the knowledge base for a great article on how to do this if you're unfamiliar.

Pipe lengths are always 100% accurate at all times!

Parameters in the parts give us a running tally of the project cost as we modify design…instantaneously!

Project Cost Estimation

Name	Quantity (per unit or per ft)	Fitting Cost	Install Cost	Total Cost
90_ELBOW	3	1.10	0.45	4.65
PUMP1	1	35.65	2.75	38.40
T-FITTING	1	2.45	0.85	3.30
VALVE1	2	8.75	1.35	20.20
Grand Total Fittings Cost		$66.55		

Pipe Information

Stock Name	Stock Length	Material	O.D.	Wall Thickness
HOSE	37.307	Plastic	0.750	0.125
PVC	86.094	PVC	0.750	0.125

Picture #18

Quick Summary of Steps

1) Create your line stocks. (Save this as a library so you don't have to recreate).
2) Route your lines (use simple "Connects" if possible).
3) Insert your fittings.
4) Make the pipes solid parts.

Remember:

1) All fittings, valves, etc. must have a coordinate system that defines the z-axis of entry for a pipe/tube coming into it.
2) Flexible tubes require points to route a best-fit spline through.

Additional Reading:

- Pro/Piping FAQ
- Creating intelligent piping drawings with parametric reports.

Key Vocabulary for Pro/Piping:

Corner Type: ***Defined in the line stock, it specifies whether the corner will be a simple radius or a sharp 90° corner. If a fitting like an elbow is to be placed, you'll want to use a sharp corner. A line stock can be defined to have both corner types, or only one allowed.***

Flexible Pipe: ***A pipe (typically a hose) that can be routed into non-linear shapes. Its shape takes on a "best fit spline" profile as you route through points in 3d space.***

Line Stock: ***Line stock is simply the name for type of piping you'll be using. When you route a pipe, Pro/E needs to know what type you'd like to route…is it rigid or flexible, radius corners or miter, material type? Most companies create a library of standard line stocks and supply that to the users to route with.***

Pipe Line: ***This is a centerline representation of the pipe routing. In Pro/E it displays as a green line between the connections. It can represent something as simple as a pipe going from A to B or it can be as complex as being multiple pipe segments: A to B, segment C to D, segment E to F.***

Port: ***Typically found on a fitting (elbows, etc.) it is simply a coordinate system that specifies the Z direction leaving the fitting. This way Pro/E automatically knows what direction to route a pipe in and it allows a smooth 'tangential' entry if using a flexible pipe. Also, a port also defines the depth that a pipe will enter into a fitting. This is very useful for getting accurate pipe lengths from Pro/E because you can account for the actual assembled pipe length.***

Rigid Pipe: ***A pipe that can only be routed in a linear fashion. This is typical of hard plastic or metal tubing that simply goes from A to B.***

Shape Type: ***This is where you tell Pro/E whether the pipe can be flexible or rigid. It's set up in the line stock, but can be changed on the fly.***

Tutorial Evaluation:

Title:	☐ Engineer ☐ Designer ☐ Draftsmen ☐ Mfg. Engr. ☐ Tech. Pubs. ☐ Analyst
PTC Products Used:	☐ Foundation ☐ Advanced Assembly Extension ☐ Advanced Surface Extension ☐ Behavioral Modeling ☐ Intralink ☐ Modelcheck ☐ All
Time using Pro/E:	☐ 0-6 months ☐ 6-12 months ☐ 1-2 years ☐ 2-5 years ☐ 5+ years

1 – Strongly Disagree
3 – Agree
5 – Strongly Agree

1.	This tutorial content met my expectations:	.....	1	2	3	4	5
2.	The exercise was easy to understand:	.....	1	2	3	4	5
3.	This tutorial will help me on current projects:	.....	1	2	3	4	5
4.	These techniques make Pro/E a more effective tool:	.....	1	2	3	4	5
5.	These techniques will increase my speed using Pro/E:	.....	1	2	3	4	5

What concepts/techniques learned from this tutorial will you apply on the job?

1)	
2)	
3)	

What would you like to see as a future tutorial at your company?

1)	
2)	
3)	

What can be done to improve these tutorials for your company?

1)	
2)	
3)	

Additional Comments: