

TK Solver Case Study:  
Interpolating Plots with One or More Log Scales

Application developers frequently need to convert tables and plots into continuous functions so that users of the program are not required to manually look up values. TK's list function capability is perfect for handling functions of one argument,  $y = f(x)$ .

Here's an example from the book, Applied Chemical Process Design by Frank Aerstn and Gary Street.

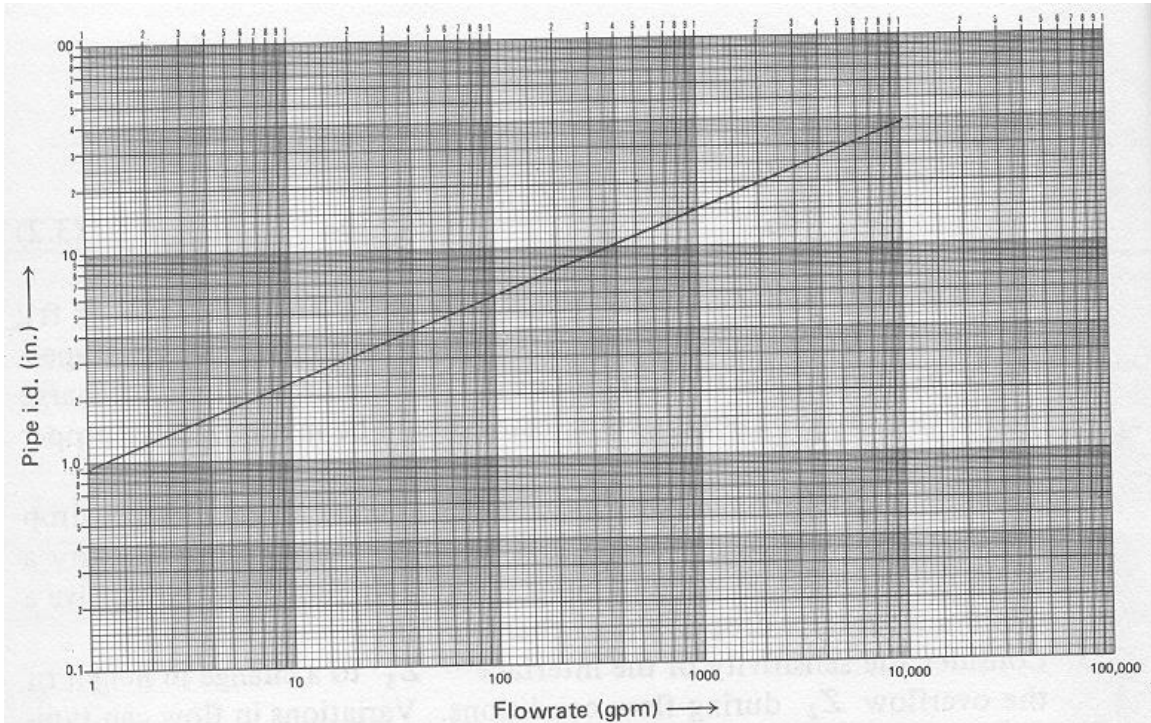


Figure 3.2.<sup>(3)</sup> Sizing discharge piping from gravity decanters.

This chart converts to a simple TK list function. First, you set up the mapping and domain and range lists.

|              |                                       |
|--------------|---------------------------------------|
| Comment:     | Sample log/log interpolation function |
| Domain List: | f1d                                   |
| Mapping:     | Linear                                |
| Range List:  | f1r                                   |

Then, you enter the domain and range values.

| Element | Domain | Range              |
|---------|--------|--------------------|
| 1       | 0      | -.0338582672609674 |
| 2       | 4      | 1.57978359661681   |

Note that the entries are the logs of the actual values. ( $\log(.925) = -.033858\dots$ )

Now the rule  $\log(\text{PipeID}) = f1(\log(\text{flowrate}))$  will return a pipe diameter given any flowrate between 1 and 10000 gpm.

| St | Input | Name     | Output     | Unit | Comment             |
|----|-------|----------|------------|------|---------------------|
|    |       |          |            |      | Gravity Decanters   |
|    |       | pipeID   | 12.2145374 | in   | Pipe inner diameter |
|    | 600   | flowrate |            | gpm  | Flow rate           |

The same rule will also backsolve for a flow rate given any pipe diameter between 0.925 and 38 in.

| St | Input | Name     | Output     | Unit | Comment             |
|----|-------|----------|------------|------|---------------------|
|    |       |          |            |      | Gravity Decanters   |
|    | 18    | pipeID   |            | in   | Pipe inner diameter |
|    |       | flowrate | 1568.84805 | gpm  | Flow rate           |

Plots with nonlinear relationships require more than two data points but the process is the same.

It is important to note that the log transformations are vital in getting accurate results. Had we set up the function with the original values, the interpolation would have been much less accurate. In fact, for a pipeID of 18, the result would have been over 4600.

A final thought... When building list functions into applications it's always a good idea to create your own error traps. In this example, if the user enters a flow rate of greater than 10000, TK will respond with "User function: Argument error" and the end user may not understand the cause. If you precede the reference to the list function with the following rules, your end users will be appreciative.

If flowrate>10000 then call errmsg("Maximum flow rate is 10000 gpm.")

If or(pipeID>38,pipeID<.925) then call errmsg("Pipe diameter must be between 0.925 and 38 inches.")