# *Pre-Setup Refrigeration User Manual, Version 1.0*

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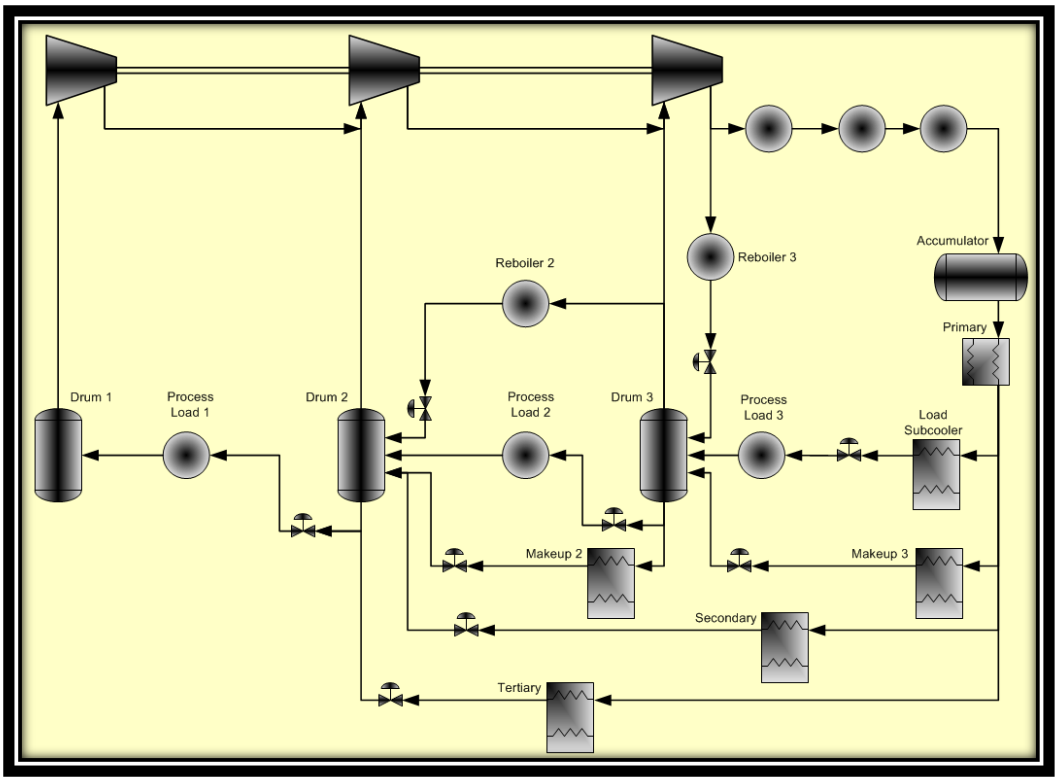

# Pre-Setup Refrigeration 1.0 User Manual

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# Pre-Setup Refrigeration User Manual

## Introduction

*Pre-Setup/packaged refrigeration, referred to hereafter as PSR 1.0 is a fast refrigeration program capable of solving one, two, three and four-stage refrigeration systems with loads, reboilers and subcoolers.*

*There is no simulation to setup, it is pre-setup for you as a package. Just enter the loads and you'll have a solution and a report in seconds. PSR 1.0 is very fast because it knows the problem it is solving. Solving a refrigeration system using a commercial simulation program can be time consuming and may require many trial and error calculations (Design-Spec/feed-back controllers) for a simple reason; it does not know the problem it is solving.*

*PSR 1.0 is aware of the problem is it solving, it can quickly determine upstream and downstream enthalpies and, given the duties, it arrives at the flowrates that satisfy the heat and material balance.*

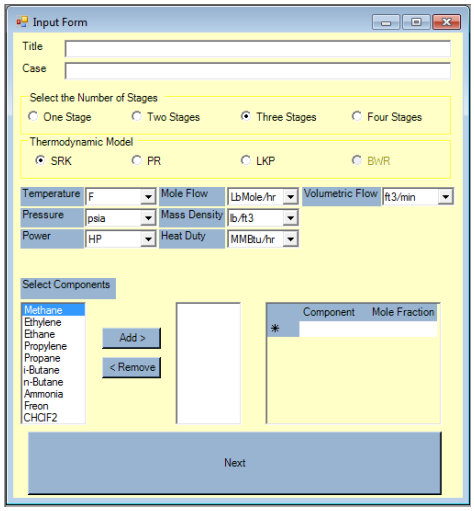
*There is a lot of input that goes into a refrigeration system other than the heat duties: pressure drops, compressor efficiencies, heat leaks, etc. We stored all these for you in a defaults file. Once you install the PSR 1.0, you may override the defaults with your own, save them, and never worry about them again. Furthermore, these defaults are available for you in a separate tab, you can conveniently change them at any time.*

*PSR 1.0 allows the use of several equations of state: Soave-Redlich-Kwong, Peng-Robinson and Lee-Kessler. PSR 1.0 allows a practical range of input units.*

## Program Input

### The Startup form

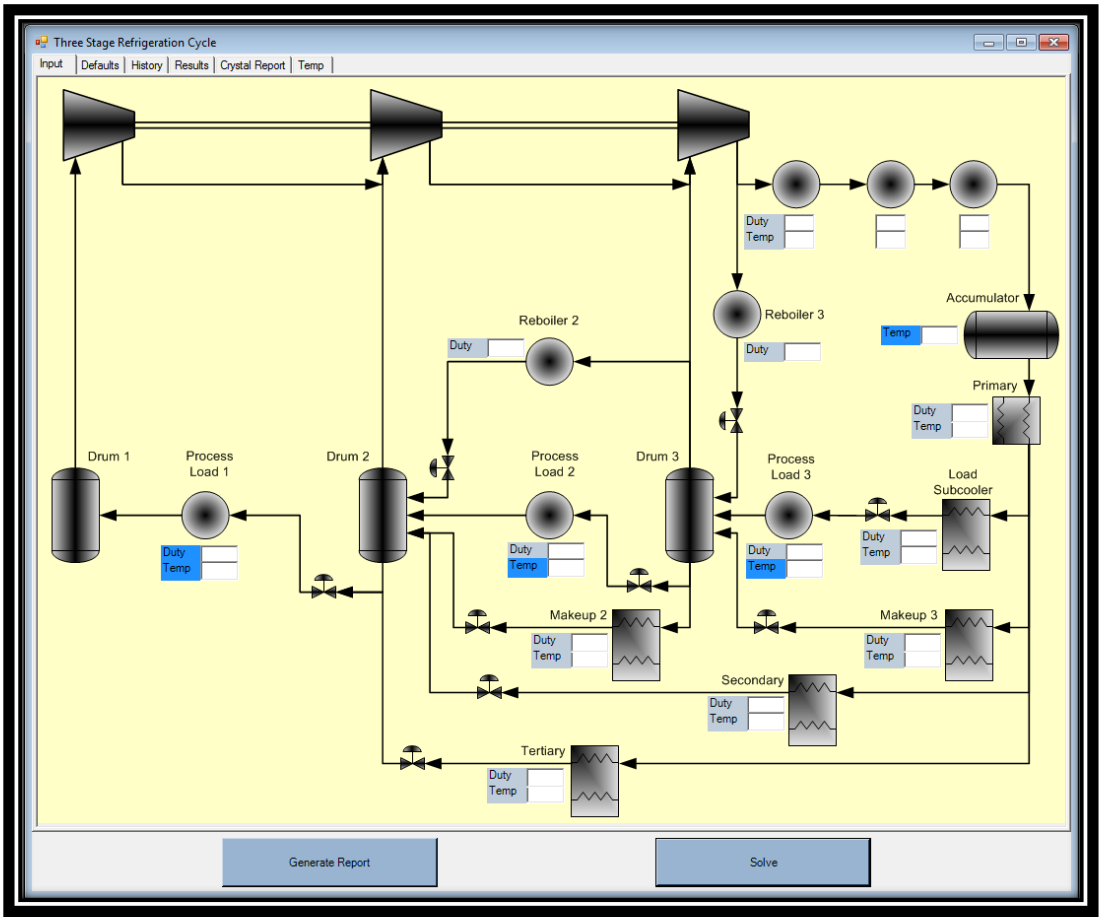
*Upon starting PSR 1.0, an input form appears. It allows entering the title, the case, selecting the number of stage, the equation of state, units of measure, the refrigerant(s) and composition.*




*At the bottom left of the form is the list of available components. Click on a component then click the add button to add it to the components to be used in the simulation. If you make a mistake, click on the component you wish to remove then click the remove button. If you select one component, you do not need to enter the mole fraction of the component. PSR 1.0 is smart enough to set it to 1.000. If you select more than one component then enter the mole fraction of each component. This composition at the accumulator.*

*Click the Next button and PSR 1.0 will open a form which corresponds to the number of stages you selected.*

*If you which to change the entries you just make click "Edit" on the main menu, then Basis. You will be able to change any of the entries you already made except for the number of stages. The following is the form for a three-stage refrigeration system.*




## Required Entries

*On every form (one-stage, two-stage, three-stage and four-stage) the required entries have labels in a dodger blue color. The first entry on the right is the accumulator bubble point temperature. Each process load requires a temperature. This is the dew point temperature out of the load heat exchanger. The first stage requires a temperature as well as a heat load. Once you click solve, PSR 1.0 will check the required entries. If any is missing, it will display a message in a window and turn the background color of that entry to red.*

*No other entries are required.*

## The Accumulator, Primary subcooler, desuperheaters and the condenser

*Only one entry is required for the accumulator: The temperature. This is the bubble point temperature at the accumulator.*

*The Primary Subcooler: All refrigeration simulations allow for the subcooling of the liquid from the accumulator. Only one entry is allowed: a temperature or a heat duty.*

*Desuperheaters and the condenser: All refrigeration simulations allow for two desuperheaters followed by the condenser. Entries for the desuperheaters and the condenser are NOT required. Each desuperheater allows one of two entries, a temperature or a heat duty. You may enter a temperature for one and a heat duty for another or vice versa. There is no restriction.*

*The condenser: No entries are required for the condenser. PSR 1.0, will take the outlet from the desuperheaters, if any is used, or the compressor discharge, if no desuperheaters are used, and condense it to the bubble point temperature specified at the accumulator.*

## *The accumulator liquid flow rate*

*The liquid flow rate from the accumulator is what the program is solving for. By an iterative process, the program determines the liquid flow rate needed from the accumulator to satisfy the process loads while taking credit for the reboilers and subcoolers if any.*

*As you go through the input, you will notice that some subcoolers require both entries: outlet temperature and heat duty while others allow only one entry. The reason is that a specification of temperature and duty fixes the flow rate and there are certain streams in the simulation which have to get calculated as part of the calculation of the liquid from the accumulator.*

## *The Load and makeup subcoolers*

*The load subcooler is one of the subcoolers which allows only one specification: either temperature or heat duty but not both. Note the location of the makeup subcooler; it is upstream of the process load. If temperature and heat duty where allowed then the flowrate of this stream is fixed. This flow rate may not be the flow that satisfies the heat duty for the downstream process load.*

*The makeup subcoolers are the same way. They reside on the makeup line. For the same reason, the flow rate of this stream cannot be fixed, thus, the makeup subcoolers will only allow one specification: either temperature or heat duty, but not both.*

## *Secondary, Tertiary and Quaternary subcoolers.*

*These subcoolers REQUIRE both specifications: temperature and heat duty in order to calculate the flow rate of the stream. Note, there can only be one "floating" stream and that's the makeup line. Thus, these subcoolers have to have both temperature and heat duty in order to fox the flow rate.*

## *Reboilers*

*Reboilers are another way to take credit on a refrigeration system. Reboilers require only one entry: the heat duty. In PSR 1.0, a reboiler will take vapor from the drum it is connected to. If the drum vapor flow rate is not enough to satisfy the reboiler heat duty, then it will extract additional vapor from the compressor.*

## *The defaults*

*Aside from heat duties and temperatures, there are far more entries that are needed for a proper simulation of a refrigeration system. There are compressor efficiencies, pressure drops through heat exchangers, pressure drops from drums to compressor suctions, etc. These values however are likely to be the same from one simulation to*

*another. PSR 1.0 has default values built in. You can view them in the Defaults tab. These values may be changed simply by typing over them then running the simulation.*

*If you save a simulation to a file, the defaults used for that simulation are saved with it in the input file, so, the next time you open this file, the values displayed for defaults in the Defaults tab will be the values used last time the simulation was saved.*

*In conclusion, the defaults are need only the first time you create a simulation from scratch. If you expect to be doing so often, then you may wish to save a defaults file and load it whenever you start a simulation from scratch.*

## Results and Other Tabs

*All refrigeration forms (one-stage, two-stage, etc) contain the same tabs: Input, Defaults, History, Results, Temp and Crystal Report. The following is a description of each tab.*

### The History tab

*The history tab contains intermediate results. It is output as PSR 1.0 is iterating while arriving at the final solution.*

*In the event that something goes wrong, the history might be able to help you determine where the calculations began to go wrong. This might help you determine which part of the input may have a typo.*

### The Results Tab

*The results tab contains the results of the simulation in tabular form. The results are divided into sections: The compressor stages, the drums, process loads, Desuperheaters & Condenser and the subcoolers. Each section contains results pertinent to that specific section.*

### The Crystal Report Tab

*The crystal report tab is empty. Once the simulation is converges, click Generate Report and PSR 1.0 will generate a report which can be printed or saved as a PDF file.*

*Crystal reports is a third party component created to facilitate printing which is currently limited in the Visual Studio.*

*Note that the File/Print in the main menu does NOT print this report. Use the print icon inside this crystal report tab to print the report.*