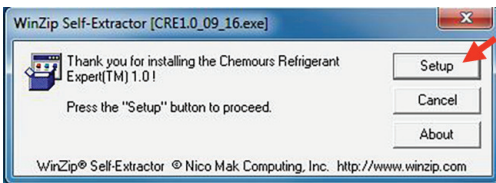


Chemours Refrigerant Expert (CRE)

User Guidelines

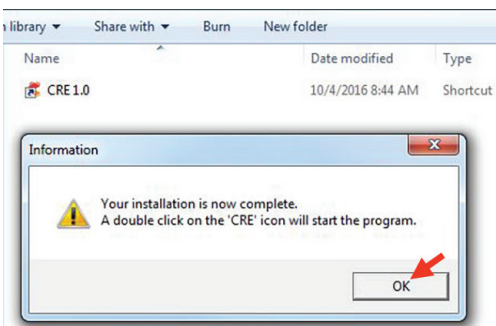
Installation step 1



Installation step 2



Installation step 3



What is CRE 1.0?

CRE 1.0 is a software tool specifically developed to allow users to easily and quickly generate data for refrigerants from Chemours including:

- Thermodynamic property data tables,
- Transport property data tables, and
- Theoretical refrigeration cycle calculations with cycle properties and line sizing data.

Data is supplied for a variety of direct expansion systems (i.e., single stage, single stage with internal heat exchanger, two stage cascade, and single stage heat pump).

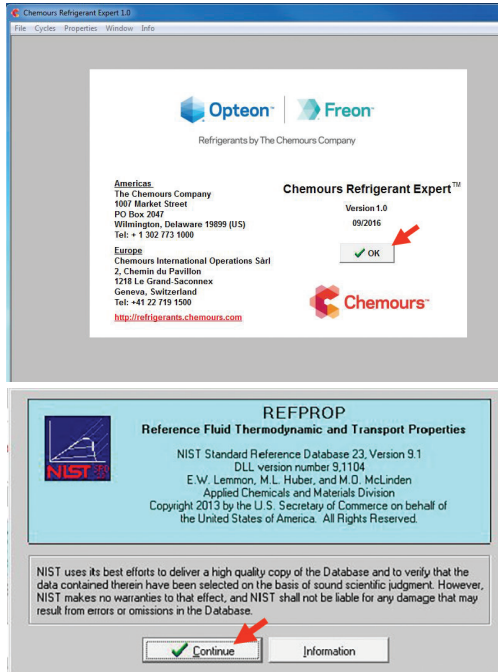
Installation

- 1 To begin the installation, double click the CRE 1.0 file in the compressed folder to open the WinZip® self-extractor window, and click on the **Setup** button.
- 2 This will open the initial installation window, where the default units, program location, and language can be changed if required. The choice of units and language can also be changed after CRE 1.0 has been installed.


To proceed with the installation, click on the **Install** button.

- 3 Once the installation has finished, a window will open and an information box will appear to confirm completion. Click on the **OK** button to clear the information box. The open window contains a shortcut to the CRE 1.0 software, which can be copied to your desktop if desired. CRE 1.0 is automatically added to the program list in the **Windows® Start-All Programs** menu and may be found in the Chemours folder.

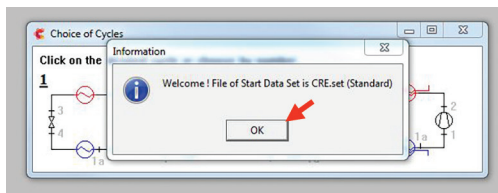
Overview step 1




Software overview

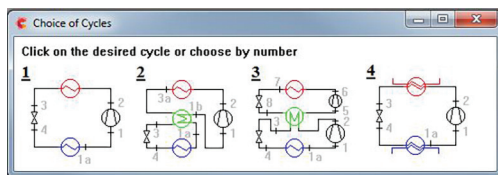
- 1 Upon start-up of the CRE 1.0 software, a welcome screen appears with Chemours contact information. Just click on the **OK** button to proceed. A disclaimer statement will appear. You will be required to agree to the terms and conditions of the disclaimer statement to continue; select **YES** to proceed. A **NO** response will stop the software installation. CRE 1.0 is based on the well-known REFPROP software; and upon start-up, a window for REFPROP will also open (this may be behind the CRE 1.0 windows); just click on  and it will disappear.
- 2 The next screen gives the file name for the default settings; just click on the **OK** button. The information box disappears, leaving the choice of direct expansion refrigerant cycles.
 1. single stage,
 2. single stage with internal heat exchanger,
 3. cascade system, or
 4. single stage heat pump.
- 3 Hold the cursor over one of the diagrams. This will cause an information box to appear. Select the desired cycle stage:
 1. single stage,
 2. single stage with internal heat exchanger,
 3. cascade system, or
 4. single stage heat pump.

Overview step 2



To return to the menu for additional functions, click the  in the top right corner.

Overview step 3

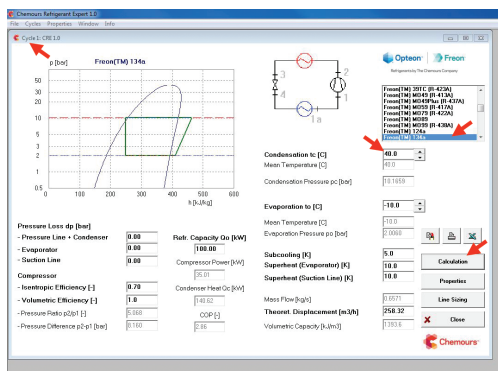


Cycle calculations

The type of cycle to be calculated can be selected either during the program start-up or from the **Cycles** main menu option at the top left of the screen. Select a designated refrigerant from the drop-down menu on the right side of the screen. The parameters in bold type can be altered to those required. After entering the required data, press the return key on your keyboard or click on the **Calculation** button to run the calculation.

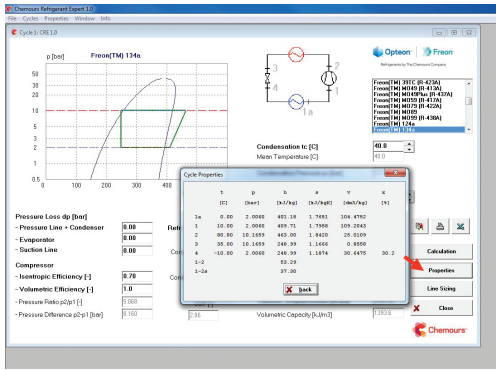
NOTE: The condensation and evaporating temperatures are the **dew point condition**. It is normal when using a refrigerant with a temperature glide to use the mean evaporating and condensing temperatures as the reference points. This can be done by adjusting the input temperatures manually until the mean temperature reads the desired value. It should also be noted that the Refrigeration Capacity and compressor Theoretical Displacement are dependent on each other and cannot both be defined. If the capacity is defined, this will remain constant and the displacement will vary with different conditions or refrigerants, and vice versa if the displacement is defined.

Calculations screen



If measurements from a system are known, the system can be modeled by entering the data into CRE 1.0. If the compressor displacement, power, and discharge temperature are known, then adjustment of the compressor volumetric and isentropic efficiencies can be used to determine the system capacity.

Calculations - Properties screen



To view the thermodynamic property data for the calculated cycle, including the compressor discharge temperature, click on the **Properties** button.

The results of the calculation can be:



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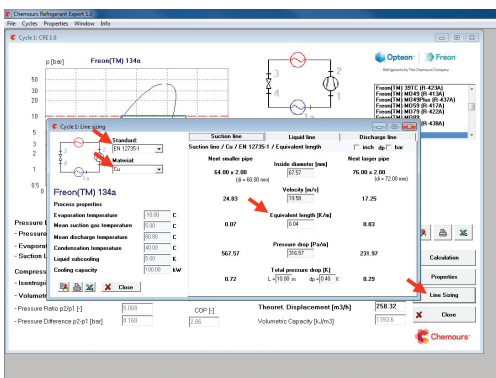
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copied to the clipboard in a format suitable to paste into Microsoft® Excel®.

More than one cycle calculation window can be opened at the same time.

Calculations - Line Sizing screen



To view the suction, liquid, and discharge line sizing data for the calculated cycle, click on the **Line Sizing** button.

In the upper left of the screen, select the **Material** (copper—Cu or steel—St) and the **Standard** (for copper—ASTM B88 Type L or EN 12735-1; for steel—ASTM A53 B-ST, EN 10220 R1, or EN 10305-1) to specify the type of tubing and the tube/pipe sizing standard to be used in the line sizing calculation for the cycle.

The line sizing calculation is based on a desired total pressure drop expressed in temperature drop/unit length of tubing. For English units, the default values are 2°R/100 ft for the suction and discharge lines and 1°R/100 ft for the liquid line. For SI units, the default values are 0.4°K/10 m for the suction and discharge lines and 0.2°K/10 m for the liquid line. This value can be changed by adjusting the value in the **Equivalent length** box in the center of the screen.

The program calculates an inner tubing diameter, velocity, and pressure drop for the desired total pressure drop, as well as for the next smaller and next larger tube/pipe sizes, based on the tubing material and tube/pipe sizing standard selected.

The results of the calculation can be:



copied onto the clipboard and pasted into other documents as a picture,

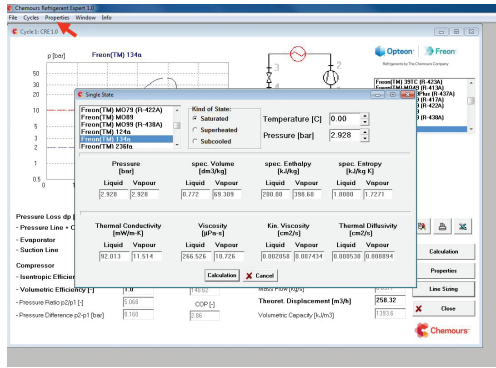


printed to hard copy, or



copied to the clipboard in a format suitable to paste into Microsoft® Excel®.

Property Calculations - Single State



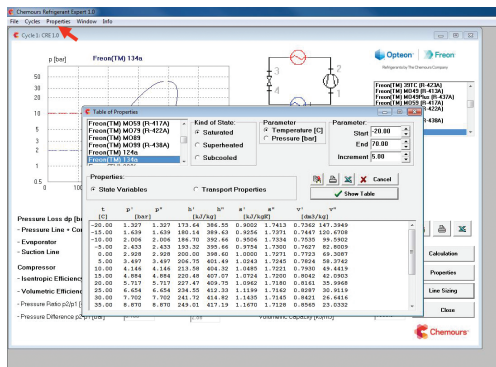
Properties calculation

Selection of **Properties** on the main menu at the top left of the screen will reveal three options: **Single State, Tables or Units**.

Single State

Selection of the single state option opens a window that allows the calculation of pressure/temperature, specific volume, enthalpy, entropy, thermal conductivity, viscosity, kinematic viscosity, and thermal diffusivity for the liquid and vapor phases in the saturated, superheated, or subcooled regions for the refrigerant chosen from the list.

Property Calculations - Tables



Tables

Selection of the tables option allows the calculation of thermodynamic (**State Variables**) or **Transport Properties** tables for a refrigerant selected from the list in the upper left hand side of the window. Select the refrigerant, select the **Kind of State** (Saturated, Superheated, or Sub-cooled), and select **Temperature or Pressure** as the defined parameter. Next, select the **Start and End** values for the defined parameter and the **Increment**. Press the enter key on your keyboard or click on the **Show Table** button to generate the table. The results of the table calculation can be copied to the clipboard, printed, or copied and pasted into Microsoft® Excel® the same way as the cycle calculations.

Units

This allows the calculation units to be changed to either SI units (bar and °C) or English engineering units (psi and °F). Any calculation windows open will close if the calculation units are changed. The following reference states are used for enthalpy and entropy calculations:

Info-Refrigerants Option screen



Refrigerant	ASHRAE ⁽¹⁾	Replaces	Bubble Point ⁽¹⁾	Bubble Point ⁽¹⁾	Dew Point ⁽¹⁾	Dew Point ⁽¹⁾	ODP ⁽²⁾	AR4 ⁽³⁾	AR5 ⁽³⁾	Safety Classification
			°C	°F	°C	°F				
Opteon™ XP10	R-513A	R-134a	-29.23	-20.61			0	631	573	A1
Opteon™ XP30	R-514A	R-123	29.65	84.29			0	9	2	B1
Opteon™ XP40	R-449A	R-454A R-507A	-45.99	-50.79	-39.93	-39.87	0	1397	1282	A1
Opteon™ XP44	R-452A	R-404A	-47.03	-52.66	-43.21	-45.79	0	2140	1945	A1
Opteon™ YF74.10	R-1234yf	R-134a	-29.49	-21.08			0	4	1	A2L
Opteon™ XL20	R-454C	R-404A R-22	-45.91	-50.64	-37.75	-35.95	0	148	146	A2L
Opteon™ XL40	R-454A	R-404A R-407C	-48.47	-55.25	-42.51	-44.52	0	246	244	A2L
Opteon™ XL14	R-454B	R-410A	-50.87	-59.56	-49.93	-57.88	0	466	467	A2L
Opteon™ XL55	R-452B	R-410A	-50.98	-59.76	-50.22	-58.4	0	698	676	A2L
Opteon™ MZ	R-136mzz22	R-245fa	33.5	92.3			0	1	2	A1
Freon™ MO29	R-422	R-22	-43.2	-45.76	-38.34	-37.01	0	2729	2673	A1
Freon™ 391C	R-423A	R-12	-34.18	-11.52	-23.51	-10.32	0	2280	2274	A1
Freon™ MO49	R-413A	R-12	-33.39	-28.11	-28.06	-18.51	0	2053	1144	A2 ⁽¹⁾
Freon™ MO49 Plus	R-437A	R-12	-32.32	-26.18	-28.05	-18.48	0	1805	1639	A1
Freon™ MO59	R-417A	R-22	-39.07	-38.32	-34.08	-29.34	0	2346	2127	A1
Freon™ MO79	R-422A	R-22	-46.5	-51.69	-44.03	-47.26	0	3143	2847	A1
Freon™ MO89	R-13B1	R-134a	-53.4	-64.12	-50.34	-58.61	0	3895	3324	A1
Freon™ MO99	R-438A	R-22	-42.33	-44.19	-36.14	-33.05	0	2254	2059	A1
Freon™ 124a	R-124	R-114	-11.97	10.46			0.022	669	527	A1
Freon™ 134a	R-134a	R-12	-26.07	-14.93			0	1430	1300	A1
Freon™ 235fa	R-235fa	R-114	-1.49	29.31			0	3810	8950	A1
Freon™ 404A	R-404A	R-22	-46.22	-51.2	-45.47	-49.85	0	3922	2943	A1
Freon™ 407A	R-407A	R-404A R-507A	-45.01	-49.02	-38.6	-37.48	0	2107	1923	A1
Freon™ 407C	R-407C	R-22	-43.63	-46.53	-36.63	-33.93	0	1774	1624	A1
Freon™ 410A	R-410A	R-22 New Equipment	-51.44	-60.6	-51.36	-60.46	0	2088	1924	A1
Freon™ 507	R-507A	R-22	-46.74	-52.13			0	3985	3985	A1
Freon™ 95	R-608B	R-13 R-603	-87.6	-125.68			0	13396	5704	A1
Freon™ MP39	R-401A	R-12	-32.93	-27.26	-27.19	-16.94	0.037	1182	1128	A1
Freon™ MP66	R-401B	R-12	-34.55	-30.18	-28.98	-20.77	0.04	1288	1236	A1
Freon™ HP80	R-402A	R-502	-48.93	-56.08	-47	-52.6	0.021	2198	2271	A1
Freon™ HP81	R-402B	R-502	-47.04	-52.67	-44.83	-48.69	0.033	2416	2260	A1
Freon™ 408A	R-408A	R-502	-44.58	-48.24	-41.12	-47.42	0.026	3152	2430	A1
Freon™ 409A	R-409A	R-12	-34.45	-30.91	-25.36	-14.72	0.048	1556	1485	A1

Other program settings

Language selection

Select your language of choice from the **File-Language** option on the main menu bar by placing your cursor over the desired language. Any calculation windows open will close if the language is changed.

Printer selection

CRE 1.0 will automatically defer to the default printer of your computer. If an alternate computer is desired, select the **File-Printer Selection** option on the main menu.

Additional information

For additional information, such as Ozone Depletion Potential, Global Warming Potential, and ASHRAE Safety Classification, select the **Info-Refrigerants** option on the main menu.

For more information on refrigerants, visit refrigerants.chemours.com/manage22 or call 877-662-4322.

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