Sage Model Notes

VariableVolumeSpace.scfn

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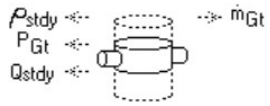
Stirling-cycle compression spaces or expansion spaces are examples of variable-volume spaces. From a modeling point of view both are essentially identical.

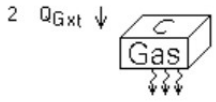
The parent component for all variable-volume spaces is the generic cylinder, available in the *Basic* page of the component palette:



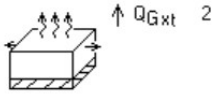
generic cylinder

The dotted connector arrows originate in lower-level model components as explained below. Eventually, you will want to connect the gas-inlet $\dot{m}_{Gt}$ arrow to another gas domain, the charge-line ρ_{stdy} arrow to a pressure source, the volume-displacement P_{Gt} to a piston area attachment, and the heat-flow Q_{stdy} connector to a temperature source. Depending on the lower-level model components you choose to implement the connector arrows will differ.

Within the generic cylinder are child components cylinder-space gas (representing the gas domain) and one of several possible components implementing thermal boundary conditions imposed on the gas. In the present case a thick surface representing a relatively massive cylinder wall that is thermally isolated from a heat source or sink.



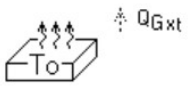
cylinder-space gas



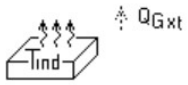
thick surface

The cylinder-space gas is available in the Gas Domain page of the component palette available within the generic cylinder. There is also a combustion-space gas component available, which provides an internal heat source as an input variable.

The thick surface is available in the Cylinder Walls page of the component palette. There are a whole family of other components also available representing other types of thermal boundary conditions. Most notably the following:



isothermal surface



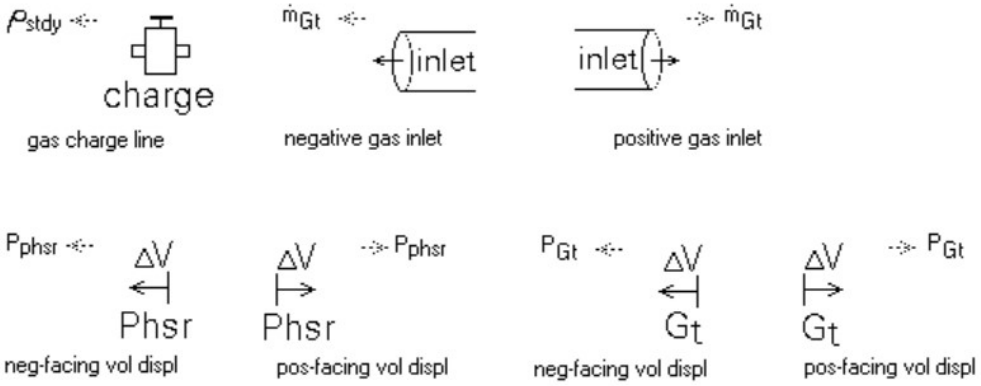
independent isothermal surface

conductive surface

surface heater

From left to right these provide a fixed temperature boundary with temperature set by the parent component `Tinit` variable, a fixed-temperature boundary with temperature set by an independent input (which can be recast or optimized), a conduction path to other solid thermal components and a fixed heat source with heat flux set by an independent input.

Within the cylinder-space gas are a number of optional components in the Charge/Inlets and Volume Displacements pages of the component palette:



These are all initially created with unconnected connectors (dotted arrows). They can be moved up to higher level components for connection to similar, opposite-directed connectors from other components using the red up-arrow tool in the Sage Toolbar:

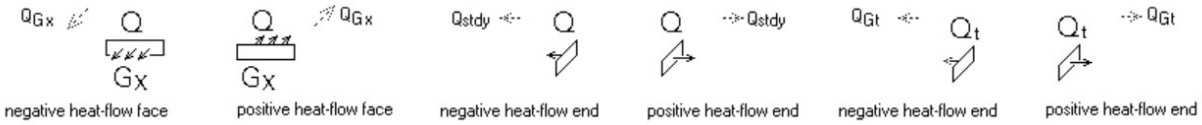
The gas charge line is used to establish the mean pressure of the gas domain and thereby the constrain the mean pressure of all interconnected gas domains of the whole model. Typically only one gas domain in an interconnected network of gas domains can have a charge line. Otherwise a solution singularity may result. Generally, the compression-space gas domain is a good place for the charge line.

The gas inlets provide the means for connecting gas flow from one gas domain to another. You may drop more than one gas inlet into a gas space. There are no restrictions. Even two or more in the same direction are possible.

The volume displacements provide a means for external components to change the gas volume via phasor or time-ring pressure connectors. Pressure connectors are available in components that solve for a pressure variable as a function of a volume-displacement boundary condition ΔV. Gas domains also solve for pressure as a function of ΔV. A volume-displacement connection solves for the ΔV common to both components that makes their pressures equal. Phasor vol displacements get connected to phasor moving parts (representing pistons and displacers) and Gt vol displacements to Gt moving parts with higher-harmonic content.

then drop in the appropriate sort of gas inlet from the {\em Charge/Inlet} page of the palette, in this case a positive gas inlet.

Within the thick surface are a number of optional components in the component palette representing heat-flow connection options:



These are all initially created with unconnected heat flow connectors. As with the cylinder-space gas components theses that can be moved up to higher level components for connection to similar, opposite-directed connectors from other components.

The present model includes only a negative heat flow end for which the connector arrow has been moved up to the generic cylinder level.