Sage Model Notes

RadCanEncl.ltc

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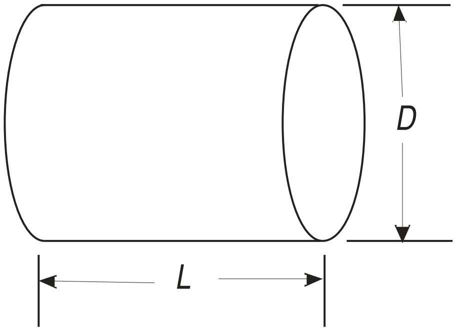
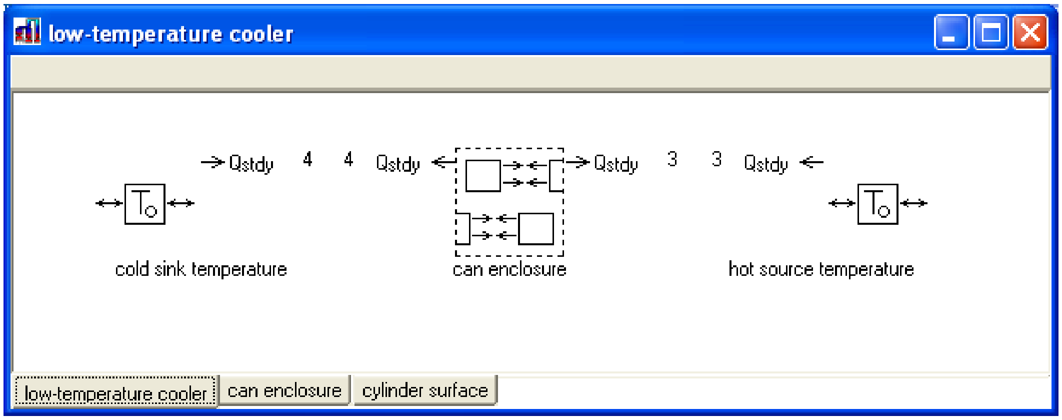
A radiation enclosure consisting of a the inner surface of a right circular cylinder exchanging radiation with base and top surfaces:



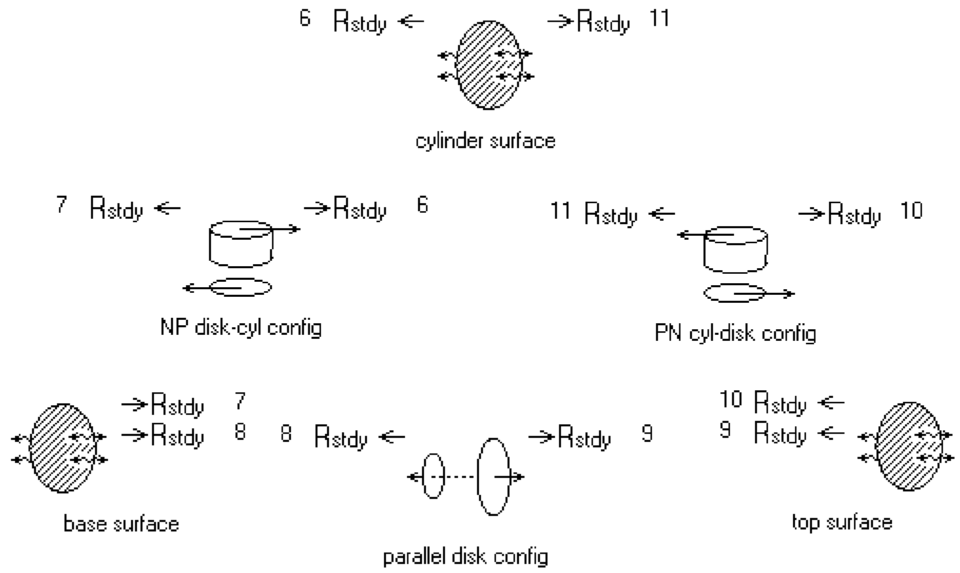
The base and top are anchored to external fixed temperatures. Of interest is the net radiation exchange between the base and top surfaces. The cylindrical surface is insulated from its surroundings and its temperature adjusts so that the net radiation heat transfer is zero.

This is the top level Sage model:

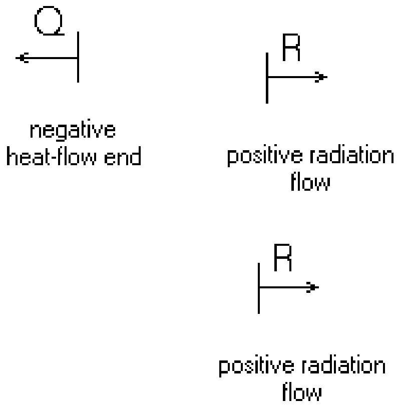


The *cold sink temperature* and *hot source temperature* anchor the two ends of the can (base and top) located within the *can enclosure* submodel.

All the radiation exchange details are within the *can enclosure* submodel which looks like this inside:



There are three radiation surfaces (shaded icons) exchanging radiation with each other through connections to three view factor components. As in all radiation enclosure models each radiation surface exchange radiation with all other radiation surfaces – in this case two other surfaces. The Qstdy connectors emerging from the *can enclosure* submodel at the root level originate in the *base surface* and *top surface* components. For example the connector attachments dropped into the *base surface* are shown here:



The *negative heat-flow end* connected to an external temperature source is what makes the *base surface* isothermal. The *cylinder surface* has no such connection so its temperature floats as part of the solution.

The three view-factor components (*NP disk-cyl config, PN cyl-disk config, parallel disk config*) calculate the view factors for the various view configurations of the enclosure. Each view configuration is evident from the component icon.

Recast Variables

User-defined inputs at the can enclosure submodel level define the overall geometry and radiation properties of the enclosure:

Dcan	can diameter (m)	1.000E-02
Lcan	can length (m)	5.000E-02
EmCan	emissivity all surfaces (NonDim)	5.000E-01

These inputs are referenced by recast inputs of the individual radiation-surface and view-factor components within the submodel, making it easy and somewhat foolproof to change the can specifications without bothering to manually adjust individual component inputs. The recast inputs are:

base surface **and** ***top surface***
A = 0.25 * Pi * Sqr(Dcan)
Emiss = EmCan

cylinder surface
A = Pi * Dcan * Lcan
Emiss = EmCan

parallel disk config
Sepr = Lcan

These recasts set the surface areas (A) according to the can geometry. The separation between disks (Sepr) in the *parallel disk config* is the can length.

Net Radiation transfer

The net radiation transfer between the can top and base is given by output Rad in either the *base surface* or *top surface.* In the *base surface* the result is:

Rad	net incoming radiation flow (W)	9.061E-03

View Factor Consistency Check

According to standard radiation enclosure theory all the radiation leaving any surface of the enclosure must reach another surface or itself. Sage uses this fact to calculate the implied self-view factor for each radiation surface as output Fself.

You can use this output as a consistency check on your model by verifying that Fself is zero (or close to zero) for any surface that is not supposed to see itself. In the present example the *base surface* and *top surface* represent flat disks that cannot see themselves, so their self view factors should be zero. And they are. On the other hand the *cylinder surface* represents the inside surface of a cylinder that can see itself. So its self view factor should not be zero. And it is not.

The rule to keep in mind is this: For a surface representing a flat or convex surface the self view factor output Fself should be zero. If it is not that means either more than or less than the correct amount of radiation is going to other surfaces of your model. In some cases this can be intentional as a model simplification. In that case the magnitude of Fself can give you an idea how big the error is. The error is probably acceptable if Fself is *small*.