Design of Gridded-Tube Structures for the 201.25 MHz RF Cavity

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Design considerations

- Design variables:
  - Tube outer diameter, wall thickness
  - Geometrical configuration:
    - Grid spacing between tubes
    - Gap between tubes
  - Type of coolant flowing inside the tubes and flow rate

- Design objective:
  - Select design variables to keep stresses/out-of-plane deflection within the acceptable limits
Heat transfer considerations

Heating of aluminum tubes due to RF radiation.
Forced convection due to coolant passing through the tubes.
Thermal stress analysis

- Structural finite element model
  - Beam elements to model the tubes
  - Shell elements to model the ring structure

- Mechanical properties and dimensions:

<table>
<thead>
<tr>
<th>$E$ (GPa)</th>
<th>$v$</th>
<th>$\alpha \times 10^{-6}$</th>
<th>$\frac{\text{in}}{\text{in}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>0.33</td>
<td>24</td>
<td>0.75</td>
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<table>
<thead>
<tr>
<th>$Ro$ (in)</th>
<th>$t$ (in)</th>
<th>$D$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>0.001</td>
<td>16.55</td>
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Gridded-tube structure subjected to uniform temperature increase

- ABAQUS
- Thermal buckling occurs at a temperature rise of 69 K
Present focus

Complete heat transfer analysis (collaboration with R. Rimmer)

Perform thermal stress analysis

Selection of design variables